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ABSTRACT

This document, which lists the technical automotive technologies competencies identified by representatives from business, industry, and labor as well as technical educators throughout Ohio, is intended to assist individuals and organizations in developing college tech prep programs that will prepare students from secondary through post-secondary associate degree programs for employment as automotive service technicians. (Automotive service technicians are individuals who apply technical knowledge and skills to diagnose, repair, service, and maintain all types of automotive vehicles.) The technical competencies are listed in the following categories: (1) preparation in all of the eight National Institute for Automotive Service Excellence (ASE) skill areas suspension and steering, brakes, electrical/electronic systems, engine performance, engine repair, heating and air conditioning, automatic transmission and transaxle, and manual drive train and axles for certification by ASE testing; (2) basic computer skills; and (3) ability to work collaboratively with others. The competencies, which are separated into essential competencies needed to ensure a minimal level of employability and recommended competencies, are organized by instructional units and include suggestions as to when students should be introduced to and proficient at them. Includes a list of technical competency profile (TCP) panel members and an automotive TCP matrix. (MO)

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AUTOMOTIVE TECHNOLOGIES

State Competency Profile

Tech Prep Curriculum Services
In conjunction with
The Ohio Department of Education
And
The Ohio Board of Regents

CE 085 379

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November 16, 1999 & January 31, 2000

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DRAFT
Occupational Definition
Automotive Service Technician

An individual who applies technical knowledge and skills to diagnose, repair, service, and maintain all types of automotive vehicles. Technical competencies include, but should not be limited to:

? Preparation in all of the following eight ASE skill areas for certification by ASE testing:

1. Suspension and Steering
2. Brakes
3. Electrical/Electronic Systems
4. Engine Performance
5. Engine Repair
6. Heating and Air Conditioning
7. Automatic Transmission and Transaxle
8. Manual Drive Train and Axles

? Basic computer skills

? Ability to work collaboratively with others

* *

LEVELING CODES

* *

GRADE LEVEL

12 = by the end of grade 12

AD = by the end of the Associate Degree

DEPTH

I = Introduce (applies to at least three or 25% of the competency builders)

IR = Introduce and Reinforce

R = Reinforce or add depth (after introducing or proficiency)

P = Proficient (achievement of the competency)

PR = Proficient and Reinforce

OTHER (Determined by Business, Industry and Labor Panel)

Essential Competency: Competency is needed to ensure **minimal** level of employability. Entry level employees should be able to perform this competency without supervision. Competencies required for certification, licensure, and/or national skills standards should be tagged as essential.

Recommended Competency: Competency should be included but is not essential for minimal level of employability.

Delete: Competency should not be included.

Example:

BIL: Essential Recommended Delete

	12	AD
EDU	P	R

Competency: XXXXXXX

Example:

BIL: Essential Recommended Delete

	12	AD
EDU	P	R

Competency: YYYYYYY

Competency Builders:
SSS
XXX

AUTOMOTIVE TECHNOLOGIES COMPETENCY PROFILE MATRIX

Page	**Area**	**Part One: NATEF Task List by Area**
1	1	Engine Repair
4	2	Automatic Transmission and Transaxle
7	3	Manual Drive Train and Axles
10	4	Suspension and Steering
13	5	Brakes
16	6	Heating and Air Conditioning
19	7	Electrical/Electronic Systems
22	8	Engine Performance
Page	**Area**	**Part Two: NATEF Task List by Priority/Area**
1	1	Engine Repair
4	2	Automatic Transmission and Transaxle
7	3	Manual Drive Train and Axles
12	4	Suspension and Steering
16	5	Brakes
20	6	Heating and Air Conditioning
24	7	Electrical/Electronic Systems
27	8	Engine Performance
Page	**Unit**	**Part Three: Competency Profile**
1	1	Quality Assurance
4	2	Technical Recording and Reporting
6	3	Workplace Safety
10	4	Management and Supervision
17	5	Customer Relations
19	6	Troubleshooting and Repair
23	7	Electrical Theory
27	8	Equipment Maintenance
32	9	Mechanical Power Distribution
41	10	**Hydraulics and Pneumatics**
49	11	Basic Materials Science

AREA 1: ENGINE REPAIR

For every task in Engine Repair, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. General Engine Diagnosis; Removal and Reinstallation (R & R)			
1. Verify and interpret engine concern; determine necessary action.	1	*IR*	PR
2. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.	2	P	R
3. Diagnose engine noises and vibrations; determine necessary action.	3	*IR*	PR
4. Diagnose the cause of excessive oil consumption, unusual engine exhaust color, odor, and sound; determine necessary action.	3	IR	PR
5. Perform engine vacuum tests; determine necessary action.	1	P	
6. Perform cylinder power balance tests; determine necessary action.	1	P	
7. Perform cylinder compression tests; determine necessary action.	1	P	
8. Perform cylinder leakage tests; determine necessary action.	1	P	
9. Remove engine (front-wheel drive); prepare for disassembly.	3	IR	PR
10. Reinstall engine (front-wheel drive).	3	IR	PR
11. Remove engine (rear-wheel drive); prepare for disassembly.	3	IR	PR
12. Reinstall engine (rear-wheel drive).	3	IR	PR
B. Cylinder Head and Valve Train Diagnosis and Repair			
1. Remove cylinder head(s); visually inspect cylinder head(s) for cracks; check gasket surface areas for warpage and leakage; check passage condition.	2	P	R
2. Install cylinder heads and gaskets; tighten according to manufacturer's specifications and procedures.	2	P	R
3. Inspect and test valve springs for squareness, pressure, and free height comparison; replace as needed.	3	I	P
4. Inspect value spring retainers, locks, and valve grooves.	2	P	PR
5. Replace valve stem seals.	3	IR	PR

Task	P	12	AD
6. Inspect valve guides for wear; check valve guide height and stem-to-guide clearance; recondition or replace as needed.	3	IR	PR
7. Resurface values; perform necessary action.	2	IR	PR
8. Resurface valve seats; perform necessary action.	2	IR	PR
9. Check valve face-to-seat contact and valve seat concentricity (runout); service seats and valves as needed.	3	IR	PR
10. Check valve spring assembled height and valve stem height; service valve and spring assemblies as needed.	2	IR	PR
11. Inspect pushrods, rocker arms, rocker arm pivots and shafts for wear, bending, cracks, looseness, and blocked oil passages (orifices); perform necessary action.	2	IR	PR
12. Inspect hydraulic or mechanical lifters; replace as needed.	2	IR	PR
13. Adjust valves (mechanical or hydraulic lifters).	1	P	
14. Inspect camshaft drives (including gear wear and backlash, sprocket and chain wear); replace as necessary.	2	IR	PR
15. Inspect and replace timing belt(s), overhead camdrive sprockets, and tensioners; check belt tension; adjust as necessary.	1	P	
16. Inspect camshaft for runout, journal wear and lobe wear.	3	IR	PR
17. Inspect and measure camshaft bearing for wear, damage, out-of-round, and alignment; determine necessary action.	3	IR	PR
18. Verify camshaft(s) timing according to manufacturer's specifications and procedure.	1	P	
C. Engine Block Assembly Diagnosis and Repair			
1. Inspect and replace pans, covers, gaskets, and seals.	2	P	PR
2. Inspect engine block for visible cracks, passage condition, core and gallery plug condition, and surface warpage; determine necessary action.	2	P	PR
3. Inspect internal and external threads; restore as needed (includes installing thread inserts).	1	P	
4. Remove cylinder wall ridges.	3	P	R
5. Inspect and measure cylinder walls for damage and wear; determine necessary action.	2	IR	PR
6. Deglaze and clean cylinder walls.	1	P	
7. Inspect and measure camshaft bearings for wear, damage, out-of-round, and alignment; determine necessary action.	3	IR	PR
8. Inspect crankshaft for surface cracks and journal damage; check oil passage condition; measure journal wear; determine necessary action.	3	IR	PR
9. Inspect and measure main and connecting rod bearings for damage, clearance, and end play; determine necessary action (includes the proper selection of bearings).	2	IR	PR
10. Identify piston and bearing wear patterns that indicate connecting rod alignment and main bearing bore problems; inspect rod alignment and bearing bore condition.	3	IR	PR
11. Inspect, measure, and service pistons and pins; determine	2	IR	PR

Task	P	12	AD
necessary action.			
12. Inspect, measure, and install piston rings.	2	IR	·PR
13. Inspect, repair or replace crankshaft vibration damper (harmonic balancer).	3	P	PR
14. Reassemble engine components using correct gaskets and sealants.	2	P	R
15. Inspect auxiliary (balance, intermediate, idler, counterbalance or silencer) shaft(s); inspect shaft(s) and support bearing for damage and wear; determine necessary action; reinstall and time.	3	I	P
16. Prime engine lubrication system.	1	IR	PR
D. Lubrication and Cooling Systems Diagnosis and Repair			
1. Perform oil pressure tests; determine necessary action.	1	P	
2. Inspect oil pump gears or rotors, housing, pressure relief devices, and pump drive; perform necessary action.	3	IR	PR
3. Perform cooling system, cap, and recovery system tests (pressure, combustion leakage, and temperature); determine necessary action.	1	P	
4. Inspect, replace, and adjust drive belts, tensioners, and pulleys.	1	P	
5. Inspect and replace engine cooling and heater system hoses.	2	P	PR
6. Inspect, test, and replace thermostat and housing.	2	P	PR
7. Test coolant; drain and recover coolant; flush and refill cooling system with recommended coolant; bleed air as required.	1	P	
8. Inspect, test, remove, and replace water pump.	2	IR	PR
9. Remove and replace radiator.	2	IR	PR
10. Inspect, and test fan(s) (electrical or mechanical), fan clutch, fan shroud, and air dams.	2	IR	PR
11. Inspect auxiliary oil coolers; replace as needed.	3	P	PR
12. Inspect, test, and replace oil temperature and pressure switches and sensors.	2	IR	PR
13. Perform oil and filter change.	1	P	

AREA 2: AUTOMATIC TRANSMISSION AND TRANSAXLE

For every task in Automatic Transmission and Transaxle, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. General Transmission and Transaxle Diagnosis			
1. Identify and interpret transmission concern; assure proper engine operation; determine necessary action.	1	I	P
2. Diagnose unusual fluid usage, level, and condition concerns; determine necessary action.	1	I	P
3. Perform pressure tests; determine necessary action.	1		P
4. Perform lock-up converter system tests; determine necessary action.	2		P
5. Diagnose electronic, mechanical, hydraulic, vacuum control system concerns; determine necessary action.	1	I	P
6. Diagnose noise and vibration concerns; determine necessary action.	3		P
B. Transmission and Transaxle Maintenance and Adjustment			
1. Inspect, adjust or replace throttle (TV) linkages or cables, check gear select indicator (as applicable).	1	IR	PR
2. Service transmission; perform visual inspection; replace fluids and filters.	1	IR	PR
C. In-Vehicle Transmission and Transaxle Repair			
1. Inspect, adjust or replace (as applicable) vacuum modulator; inspect and repair or replace lines and hoses.	3	IR	P
2. Inspect, repair, and replace governor assembly.	3	I	P
3. Inspect and replace external seals and gaskets.	2	I	P
4. Inspect extension housing, bushings and seals; perform necessary action.	3	IR	P
5. Inspect, leak test, flush, and replace cooler, lines, and fittings.	1	I	P
6. Inspect and replace speedometer drive gear, driven gear, vehicle speed sensor (VSS), and retainers.	3	IR	P
7. Inspect and test, adjust, repair or replace transmission related electrical and electronic components (includes computers, solenoids, sensors, relays, switches, and harnesses).	1	I	P
8. Inspect, replace, and align powertrain mounts.	3	P	PR

Task	**P**	**12**	**AD**
D. Off-Vehicle Transmission and Transaxle Repair			
1. Removal, Disassembly, and Reinstallation			
1. Remove and reinstall transmission and torque converter (rear-wheel drive).	2	IR	P
2. Remove and reinstall transaxle and torque converter assembly.	2	IR	P
3. Disassemble, clean, and inspect transmission/transaxle.	1		P
4. Inspect, measure, clean, and replace valve body (includes surfaces and bores, springs, valves, sleeves, retainers, brackets, check-balls, screens, spacers, and gaskets), and torque valve body bolts.	2		P
5. Inspect servo bore, piston, seals, pin, spring, and retainers; determine necessary action.	3		P
6. Inspect accumulator bore, piston, seals, spring, and retainer; determine necessary action.	3		P
7. Assemble transmission/transaxle.	1		P
2. Oil Pump and Converter			
1. Inspect converter flex plate, attaching parts, pilot, pump drive, and seal areas.	2	IR	P
2. Measure torque converter endplay and check for interference; check stator clutch.	2		P
3. Inspect, measure, and replace oil pump assembly and components.	3		P
4. Check torque converter and transmission cooling system for contamination.	1		P
3. Gear Train, Shafts, Bushings and Case			
1. Measure endplay or preload; determine necessary action.	1		P
2. Inspect, measure, and replace thrust washers and bearings.	2		P
3. Inspect oil delivery seal rings, ring grooves, and sealing surface areas.	2		P
4. Inspect bushings; replace as needed.	2		P
5. Inspect and measure planetary gear assembly (includes sun, ring gear, thrust washers, planetary gears, and carrier assembly); replace as needed.	2		P
6. Inspect case bores, passages, bushings, vents, and mating surfaces; determine necessary action.	2		P
7. Inspect transaxle drive, link chains, sprockets, gears, bearings, and bushings; perform necessary action.	2		P
8. Inspect, measure, repair, adjust or replace transaxle final drive components.	2		P
9. Inspect and reinstall parking pawl, shaft, spring, and retainer; determine necessary action.	3		P
4. Friction and Reaction Units			
1. Inspect clutch drum, piston, check-balls, springs, retainers, seals, and friction and pressure plates; replace as needed.	2		P
2. Measure clutch pack clearance; adjust as needed.	1		P
3. Air test operation of clutch and servo assemblies.	1		P

Task	P	12	AD
4. Inspect roller and sprag clutch, races, rollers, sprags, springs, cages, and retainers; replace as needed.	2		P
5. Inspect bands and drums; adjust or replace as needed.	3		P

AREA 3: MANUAL DRIVE TRAIN AND AXLES

For every task in Manual Drive Train and Axles, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. Clutch Diagnosis and Repair			
1. Diagnose clutch noise, binding, slippage, pulsation, and chatter; determine necessary action.	1	I	P
2. Inspect clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs; perform necessary action.	1	I	P
3. Inspect hydraulic clutch slave and master cylinders, lines, and hoses; perform necessary action.	1	I	P
4. Inspect release (throw-out) bearing, lever, and pivot; perform necessary action.	1	I	P
5. Inspect and replace clutch pressure plate assembly and clutch disc.	1	IR	P
6. Inspect, remove or replace crankshaft pilot bearing or bushing (as applicable).	1	IR	P
7. Inspect flywheel and ring gear for wear and cracks, measure runout; determine necessary action.	1	IR	P
8. Inspect engine block, clutch (bell) housing, and transmission/transaxle case mating surfaces; determine necessary action.	3	IR	PR
9. Measure flywheel-to-block runout and crankshaft endplay; determine necessary action.	3	IR	PR
B. Transmission/Transaxle Diagnosis and Repair			
1. Remove and reinstall transmission/transaxle.	2	IR	PR
2. Disassemble, clean, and reassemble transmission/transaxle components.	2	I	PR
3. Inspect transmission/transaxle case, extension housing, case mating surfaces, bores, bushings, and vents; perform necessary action.	3		P
4. Diagnose noise, hard shifting, jumping out of gear, and fluid leakage concerns; determine necessary action.	3	I	PR
5. Inspect, adjust, and reinstall shift linkages, brackets, bushings, cables, pivots, and levers.	3	IR	PR
6. Inspect and reinstall powertrain mounts.	3	P	PR
7. Inspect and replace gaskets, seals, and sealants; inspect sealing	2	IR	PR

Task	**P**	**12**	**AD**
surfaces.			
8. Remove and replace transaxle final drive.	3	I	PR
9. Inspect, adjust, and reinstall shift cover, forks, levers, grommets, shafts, sleeves, detent mechanism, interlocks, and springs.	2	I	PR
10. Measure endplay or preload (shim or spacer selection procedure) on transmission/transaxle shafts; perform necessary action.	1		P
11. Inspect and reinstall synchronizer hub, sleeve, keys (inserts), springs, and blocking rings.	2	I	PR
12. Inspect and reinstall speedometer drive gear, driven gear, vehicle speed sensor (VSS), and retainers.	2	IR	PR
13. Diagnose transaxle final drive assembly noise and vibration concerns; determine necessary action.	3		P
14. Remove, inspect, measure, adjust, and reinstall transaxle final drive pinion gears (spiders), shaft, side gears, side bearings, thrust washers, and case assembly.	2	I	PR
15. Inspect lubrication devices (oil pump or slingers); perform necessary action.	3		P
16. Inspect, test, and replace transmission/transaxle sensors and switches.	1	I	P
C. Drive Shaft and Half Shaft, Universal and Constant-Velocity (CV) Joint Diagnosis and Repair			
1. Diagnose constant-velocity (CV) joint noise and vibration concerns; determine necessary action.	2	IR	PR
2. Diagnose universal joint noise and vibration concerns; perform necessary action.	2	IR	PR
3. Replace front wheel drive (FWD) front wheel bearing.	2	I	PR
4. Inspect, service, and replace shafts, yokes, boots, and CV joints.	1	P	PR
5. Inspect, service, and replace shaft center support bearings.	3	IR	P
6. Check shaft balance; measure shaft runout; measure and adjust driveline angles.	3	I	P
D. Drive Axle Diagnosis and Repair			
1. Ring and Pinion Gears and Differential Case Assembly			
1. Diagnose noise and vibration concerns; determine necessary action.	2	I	PR
2. Diagnose fluid leakage concerns; determine necessary action.	2	IR	PR
3. Inspect and replace companion flange and pinion seal; measure companion flange runout.	2	I	PR
4. Inspect ring gear and measure runout; determine necessary action.	2	I	PR
5. Remove, inspect, and reinstall drive pinion and ring gear, spacers, sleeves, and bearings.	2	I	PR
6. Measure and adjust drive pinion depth.	2	I	PR
7. Measure and adjust drive pinion bearing preload.	1	I	P

Task	P	12	AD
8. Measure and adjust side bearing preload and ring and pinion gear total backlash and backlash variation on a differential carrier assembly (threaded cup or shim types).	2	I	PR
9. Check ring and pinion tooth contact patterns; perform necessary action.	1	I	P
10. Disassemble, inspect, measure, and adjust or replace differential pinion gears (spiders), shaft side gears, side bearings, thrust washers, and case.	2	I	PR
11. Reassemble and reinstall differential case assembly; measure runout; determine necessary action.	2	I	PR
2. Limited Slip Differential			
1. Diagnose noise, slippage, and chatter concerns; determine necessary action.	3	I	PR
2. Inspect and flush differential housing; refill with correct lubricant.	2	P	PR
3. Inspect and reinstall clutch (cone or plate) components.	3		P
4. Measure rotating torque; determine necessary action.	3		P
3. Drive Axle Shaft			
1. Diagnose drive axle shafts, bearings, and seals for noise, vibration, and fluid leakage concerns; determine necessary action.	2	I	PR
2. Inspect and replace drive axle shaft wheel studs.	3	P	PR
3. Remove and replace drive axle shafts.	1	P	PR
4. Inspect and replace drive axle shaft seals, bearings, and retainers.	2	I	PR
5. Measure drive axle flange runout and shaft endplay; determine necessary action.	2	I	PR
E. Four-wheel Drive/All-wheel Drive Component Diagnosis and Repair			
1. Diagnose noise, vibration, and unusual steering concerns; determine necessary action.	3		P
2. Inspect, adjust, and repair shifting controls (mechanical, electrical, and vacuum), bushings, mounts, levers, and brackets.	3		P
3. Remove and reinstall transfer case.	3		P
4. Disassemble, service, and reassemble transfer case and components.	3		P
5. Inspect front-wheel bearings and locking hubs; perform necessary action.	3		P
6. Check drive assembly seals and vents; check lube level.	3	IR	PR
7. Diagnose test, adjust, and replace electrical/electronic components of four-wheel drive systems.	3		P

AREA 4: SUSPENSION AND STEERING

For every task in Suspension and Steering, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. Steering Systems Diagnosis and Repair			
1. Disable and enable supplemental restraint system (SRS) in accordance with manufacturer's procedures.	1	I	PR
2. Remove and replace steering wheel; center/time supplemental restraint system (SRS) coil in accordance with manufacturer's procedures.	1	I	P
3. Diagnose steering column noises, looseness, and binding concerns (including tilt mechanisms); determine necessary action.	3	IR	PR
4. Diagnose power steering gear (non-rack and pinion) binding, uneven turning effort, loosenesss, hard steering, and fluid leakage concerns; determine necessary action.	3	IR	PR
5. Diagnose power steering gear (rack and pinion) binding, uneven turning effort, looseness, hard steering, and fluid leakage concerns; determine necessary action.	3	IR	PR
6. Inspect steering shaft universal-joint(s), flexible coupling(s), collapsible column, lock cylinder mechanism, and steering wheel; perform necessary action.	2	IR	PR
7. Adjust manual or power non-rack and pinion worm bearing preload and sector lash.	3	I	P
8. Remove and replace manual or power rack and pinion steering gear; inspect mounting bushings and brackets.	2	P	
9. Disassemble, inspect, perform necessary action and reassemble rack and pinion steering gear.	3	I	R
10. Adjust manual or power rack and pinion steering gear.	3	I	
11. Inspect and replace manual or power rack and pinion steering gear inner tie rod ends (sockets) and bellows boots.	2	P	
12. Inspect power steering fluid levels and condition.	1	P	
13. Flush, fill, and bleed power steering system.	2	P	R
14. Diagnose power steering fluid leakage; determine necessary action.	2	P	
15. Remove, inspect, replace, and adjust power steering pump belt.	1	P	
16. Remove, inspect, and replace power steering pump, mounts, seals, and gaskets.	3	P	PR

Task	P	12	AD
17. Remove, inspect, and replace power steering pump pulley; check alignment.	3	P	R
18. Inspect and replace power steering hoses and fittings.	2	P	
19. Inspect and replace pitman arm, relay (centerlink/intermediate) rod, idler arm and mountings, and steering linkage damper.	3	P	R
20. Inspect, replace, and adjust tie rod ends (sockets), tie rod sleeves, and clamps.	2	P	
21. Diagnose and adjust components of electronically controlled steering systems; determine necessary action.	3	I	P
B. Suspension Systems Diagnosis and Repair			
1. Front Suspension			
1. Diagnose short and long arm suspension system noises, body sway, and uneven riding height concerns; determine necessary action.	1	I	P
2. Diagnose MacPherson strut suspension system noises, body sway, and uneven riding height concerns; determine necessary action.	1	I	P
3. Remove, inspect, and install upper and lower control arms, bushings, shafts, and rebound bumpers.	2	P	
4. Remove, inspect, install, and adjust strut (compression/tension) rods and bushings.	2	P	
5. Remove, inspect, and install upper and lower ball joints on short and long arm suspension systems.	2	P	
6. Remove, inspect, and install steering knuckle assemblies.	2	P	
7. Remove, inspect, and install short and long arm suspension system coil springs and spring insulators.	2	P	
8. Remove, inspect, install, and adjust suspension system torsion bars; inspect mounts.	3	P	R
9. Remove, inspect, and install stabilizer bar bushings, brackets, and links.	3	P	R
10. Remove, inspect, and install MacPherson strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount.	1	P	
11. Lubricate suspension and steering systems.	2	P	
2. Rear Suspension			
1. Remove, inspect, and install coil springs and spring insulators.	2	P	
2. Remove, inspect, and install transverse links, control arms, bushings, and mounts.	2	P	
3. Remove, inspect, and install leaf springs, leaf spring insulators (silencers), shackles, brackets, bushings, and mounts.	3	P	R
4. Remove, inspect, and install MacPherson strut cartridge or assembly, strut coil spring, and insulators (silencers).	2	P	

Task	P	12	AD
3. Miscellaneous Service			
1. Inspect, remove, and replace shock absorbers.	1	P	
2. Remove, inspect, and service or replace front and rear wheel bearings.	1	P	
3. Diagnose, inspect, adjust, repair or replace components of electronically controlled suspension systems.	2	I	P
C. Wheel Alignment Diagnosis, Adjustment, and Repair			
1. Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return concerns; determine necessary action.	1	I	P
2. Perform prealignment inspection; perform necessary action.	1	P	R
3. Measure vehicle riding height; determine necessary action.	1	P	R
4. Check and adjust front and rear wheel camber; perform necessary action.	1	P	R
5. Check and adjust caster; perform necessary action.	1	P	R
6. Check and adjust front wheel toe; adjust as needed.	1	P	R
7. Center steering wheel.	1	P	R
8. Check toe-out-on-turns (turning radius); determine necessary action.	2	IR	PR
9. Check SAI (steering axis inclination) and included angle; determine necessary action.	2	IR	PR
10. Check and adjust rear wheel toe.	2	IR	PR
11. Check rear wheel thrust angle; determine necessary action.	2	IR	PR
12. Check for front wheel setback; determine necessary action.	2	IR	PR
13. Check front cradle (subframe) alignment; determine necessary action	3	P	R
D. Wheel and Tire Diagnosis and Repair			
1. Diagnose tire wear patterns; determine necessary action.	1	P	
2. Inspect tires; check and adjust air pressure.	1	P	
3. Diagnose wheel/tire vibration, shimmy, and noise; determine necessary action.	2	P	
4. Rotate tires according to manufacturer's recommendations.	1	P	
5. Measure wheel, tire, axle, and hub runout; determine necessary action.	2	P	
6. Diagnose tire pull (lead) problem; determine necessary action.	2	P	
7. Balance wheel and tire assembly (static and dynamic).	1	P	
8. Dismount, inspect, repair, and remount tire on wheel.	2	P	
9. Reinstall wheel; torque lug nuts.	1	P	

AREA 5: BRAKES

For every task in Brakes, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. Hydraulic System Diagnosis and Repair			
1. Measure and adjust pedal height.	2	P	
2. Check master cylinder for internal and external leaks and proper operation; determine necessary action.	2	P	
3. Remove, bench bleed, and reinstall master cylinder.	1	P	
4. Diagnose poor stopping, pulling or dragging concerns caused by problems in the hydraulic system; determine necessary action.	1	P	
5. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging or wear; tighten loose fittings and supports; determine necessary action.	2	P	
6. Fabricate and install brake lines (double flare and ISO types); replace hoses, fittings, and supports as needed.	2	P	
7. Select, handle, store, and install brake fluids to proper level.	1	P	
8. Inspect, test, and replace metering (hold-off), proportioning (balance), pressure differential, and combination valves.	3	P	R
9. Inspect, test, replace, and adjust height (load) sensing proportioning valve.	3	IR	PR
10. Inspect, test, and replace components of brake warning light system.	3	P	R
11. Bleed (manual, pressure, vacuum or surge) brake system.	1	P	
12. Flush hydraulic system.	3	P	
B. Drum Brake Diagnosis and Repair			
1. Diagnose poor stopping, noise, pulling, grabbing, dragging or pedal pulsation concerns; determine necessary action.	1	P	
2. Remove, clean (using proper safety procedures), inspect, and measure brake drums; service or replace as needed.	1	P	
3. Mount brake drum on lathe; machine braking surface.	2	P	
4. Remove, clean, and inspect brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble.	2	P	
5. Remove, Inspect, and install wheel cylinders.	2	P	
6. Pre-adjust brake shoes and parking brake before installing brake drums or drum/hub assemblies and wheel bearings.	1	P	
7. Install wheel, torque lug nuts, and make final checks and adjustments.	1	P	

Task	P	12	AD
C. Disc Brake Diagnosis and Repair			
1. Diagnose poor stopping, noise, puling, grabbing, dragging or pedal pulsation concerns; determine necessary action.	1	P	
2. Remove caliper assembly from mountings; clean and inspect for leaks and damage to caliper housing; determine necessary action.	1	P	
3. Clean and inspect caliper mounting and slides for wear and damage; determine necessary action.	1	P	
4. Remove, clean, and inspect pads and retaining hardware; determine necessary action.	1	P	
5. Disassemble and clean caliper assembly; inspect parts for wear, rust, scoring, and damage; replace seal, boot, and damaged or worn parts.	1	P	
6. Reassemble, lubricate, and reinstall caliper, pads, and related hardware; seat pads, and inspect for leaks.	1	P	
7. Clean, inspect, and measure rotor with a dial indicator and a micrometer; follow manufacturer's recommendations in determining need to machine or replace.	1	P	
8. Refinish rotor according to manufacturer's recommendations.	1	P	
9. Adjust calipers with integrated parking brake system.	3	P	PR
10. Install wheel, torque lug nuts, and make final checks and adjustments.	1	P	
11. Remove and replace rotor.	2	P	
D. Power Assist Units Diagnosis and Repair			
1. Test pedal free travel with and without engine running; check power assist operation.	2	P	PR
2. Check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster.	2	P	
3. Inspect the vacuum-type power booster unit for vacuum leaks; inspect the check valve for proper operation; determine necessary action.	2	P	
4. Inspect and test hydro-boost system and accumulator for leaks and proper operation; determine necessary action.	3	P	R
E. Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, Etc.) Diagnosis and Repair			
1. Diagnose wheel bearing noises, wheel shimmy, and vibration concerns; determine necessary action.	1	P	
2. Remove, clean, inspect, repack, and install wheel bearings and replace seals; install hub and adjust wheel bearings.	1	P	
3. Check parking brake cables and components for wear, rusting, binding, and corrosion; clean, lubricate, and replace as needed.	2	P	
4. Check parking brake operation; adjust as needed.	1	P	
5. Check operation of parking brake indicator light system.	3	P	

Task	P	12	AD
6. Check operation of brake stop light system; adjust and service as needed.	1	P	
7. Replace wheel bearing and race.	1	P	
F. Anti-lock Brake System			
1. Inspect and test anti-lock brake system (ABS) components; determine necessary action.	2	I	P
2. Diagnose poor stopping, wheel lock-up, abnormal pedal feel or pulsation, and noise concerns caused by the anti-lock brake system (ABS); determine necessary action.	2	I	P
3. Diagnose anti-lock brake system (ABS) electronic control(s) and components using self-diagnosis and/or recommended test equipment; determine necessary action.	1	P	
4. Depressurize high-pressure components of the anti-lock brake system (ABS).	2	P	R
5. Bleed the anti-lock brake system's (ABS) front and rear hydraulic circuits.	2	I	P
6. Remove and install anti-lock brake system (ABS) electrical/electronic and hydraulic components.	3	I	P
7. Service, test, and adjust anti-lock brake system (ABS) speed sensors.	2	IR	PR
8. Diagnose anti-lock brake system (ABS) braking concerns caused by vehicle modifications (tire size, curb height, final drive ratio, etc.).	3	I	P

AREA 6: ELECTRICAL/ELECTRONIC SYSTEMS

For every task in Electrical/Electronic Systems, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. General Electrical System Diagnosis			
1. Use wiring diagrams during diagnosis of electrical circuit problems.	1	P	
2. Check electrical circuits with a test light; determine necessary action.	2	P	R
3. Check voltage and voltage drop in electrical/electronic circuits using a digital multimeter (DMM); determine necessary action.	1	P	
4. Check current flow in electrical/electronic circuits and components using an ammeter; determine necessary action.	1	P	
5. Check continuity and resistances in electrical/electronic circuits and components with an ohmmeter; determine necessary action.	1	P	
6. Check electrical circuits using jumper wires; determine necessary action.	2	P	R
7. Locate shorts, grounds, opens, and resistance problems in electrical/electronic circuits; determine necessary action.	1	P	
8. Measure and diagnose the cause(s) of abnormal key-off battery drain; determine necessary action.	1	P	
9. Inspect and test fusible links, circuit breakers, and fuses; determine necessary action.	1	P	
10. Inspect and test switches, connectors, relays, and wires of electrical/electronic circuits; perform necessary action.	1	P	
11. Repair wiring harnesses and connectors.	1	P	
12. Perform solder repair of electrical wiring.	1	P	
B. Battery Diagnosis and Service			
1. Perform battery state-of-charge test; determine needed service.	1	P	
2. Perform battery capacity test; determine needed service.	1	P	
3. Maintain or restore electronic memory functions.	2	P	R
4. Inspect, clean, fill, and replace battery.	2	P	PR
5. Perform slow/fast battery charge.	2	P	PR
6. Inspect and clean battery cables, connectors, clamps, and hold-downs; repair or replace as needed.	1	P	
7. Start a vehicle using jumper cables and a battery or auxiliary power supply according to manufacturers recommended specifications.	1	P	

Task	P	12	AD
C. Starting System Diagnosis and Repair			
1. Perform starter current draw tests; determine necessary action.	1	P	
2. Perform starter circuit voltage drop tests; determine necessary action.	1	P	
3. Inspect and test starter relays and solenoids; replace as needed.	2	IR	PR
4. Remove and install starter.	2	P	
5. Perform starter bench tests; determine necessary action.	3	IR	PR
6. Inspect and test switches, connectors, and wires of starter control circuits; perform necessary action.	2	P	R
7. Disassemble, clean, inspect, and test starter components; replace as needed.	3	IR	PR
D. Charging System Diagnosis and Repair			
1. Perform charging system output test; determine necessary action.	1	P	
2. Diagnose charging system for the cause of undercharge, no-charge, and overcharge conditions.	1	P	
3. Inspect and adjust generator (alternator) drive belts; replace as needed.	1	P	
4. Inspect and test voltage regulator/regulating circuit; perform necessary action.	2	P	R
5. Remove inspect, and install generator (alternator).	2	P	PR
6. Disassemble generator (alternator), clean, inspect, and test components; determine necessary action.	3	IR	PR
7. Perform charging circuit voltage drop tests; determine necessary action.	1	P	
E. Lighting Systems Diagnosis and Repair			
1. Diagnose the cause of brighter than normal, intermittent, dim, or no light operation; determine necessary action.	2	P	PR
2. Inspect, replace, and aim headlights and bulbs.	2	P	
3. Inspect and diagnose incorrect turn signal or hazard light operation; perform necessary action.	2	P	PR
F. Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair			
1. Inspect and test gauges and gauge sending units for cause of intermittent, high, low, or no gauge readings; determine necessary action.	2	I	P
2. Inspect and test connectors, wires, and printed circuit boards of gauge circuits; determine necessary action.	3	I	P
3. Diagnose the cause of incorrect operation of warning devices and other driver information systems; determine necessary action.	1	P	
4. Inspect and test sensors, connectors, and wires of electronic instrument circuits; determine necessary action.	3	I	P

Task	P	12	AD
G. Horn and Wiper/Washer Diagnosis and Repair			
1. Diagnose incorrect horn operation; perform necessary action.	3	P	R
2. Diagnose incorrect wiper operation; diagnose wiper speed control and park problems; perform necessary action.	3	IR	PR
3. Diagnose incorrect windshield washer operation; perform necessary action.	3	P	PR
H. Accessories Diagnosis and Repair			
1. Diagnose incorrect operation of motor-driven accessory circuits; determine necessary action.	2	I	P
2. Diagnose incorrect heated glass operation; determine necessary action.	3	P	PR
3. Diagnose incorrect electric lock operation; determine necessary action.	3	IR	PR
4. Diagnose incorrect operation of cruise control systems; repair as needed.	3	IR	PR
5. Diagnose supplemental restraint system (SRS) concerns; determine necessary action. (Note: Follow manufacturer's safety procedures to prevent accidental deployment.)	2	I	PR
6. Diagnose radio static and weak, intermittent, or no radio reception; determine necessary action.	3	I	P

AREA 7: HEATING AND AIR CONDITIONING

For every task in Heating and Air Conditioning, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. A/C System Diagnosis and Repair			
1. Diagnose unusual operating noises in the A/C system; determine necessary action.	2	I	PR
2. Identify refrigerant type; conduct a performance test of the A/C system; determine necessary action.	1	P	R
3. Leak test A/C system; determine necessary action.	1	P	R
4. Inspect the condition of discharged oil; determine necessary action.	2	I	P
5. Select oil type; measure, and add oil to the A/C system as needed.	2	P	PR
B. Refrigeration System Component Diagnosis and Repair			
1. Compressor and Clutch			
1. Diagnose A/C system conditions that cause the protection devices (pressure, thermal, and PCM) to interrupt system operation; determine necessary action.	2	I	P
2. Inspect A/C compressor drive belts; replace and adjust as needed.	2	P	R
3. Inspect, test, and replace A/C compressor clutch components or assembly.	2	P	R
4. Remove and replace A/C compressor and mountings.	2	P	R
2. Evaporator, Condenser, and Related Components			
1. Determine need for A/C system filter; perform necessary action.	3	P	PR
2. Remove and inspect A/C system mufflers, hoses, lines, fittings, o-rings, seals, and service valves; perform necessary action.	2	P	R
3. Inspect A/C condenser for airflow restrictions; perform necessary action.	1	P	R
4. Remove and install receiver/drier or accumulator/drier.	2	P	R
5. Remove and install expansion valve or orifice (expansion) tube.	2	P	R
6. Inspect evaporator housing water drain; perform necessary action.	3	P	R

Task	P	12	AD
C. Heating, Ventilation, and Engine Cooling Systems Diagnosis and Repair			
1. Diagnose temperature control problems in the heater/ventilation system; determine necessary action.	2	IR	PR
2. Perform cooling system, cap, and recovery system tests (pressure, combustion leakage, and temperature); determine necessary action.	1	P	
3. Inspect engine cooling and heater system hoses and belts; perform necessary action.	1	P	
4. Inspect, test, and replace thermostat and housing.	1	P	
5. Determine coolant condition; drain and recover coolant.	1	P	
6. Flush system; refill system with recommended coolant; bleed system.	1	P	
7. Inspect and test fan, fan clutch (electrical and mechanical), fan shroud, and air dams; perform necessary action.	1	P	PR
8. Inspect and test electrical fan control system and circuits.	1	IR	PR
9. Inspect and test heater control valve(s); perform necessary action.	2	P	R
D. Operating Systems and Related Controls Diagnosis and Repair			
1. Diagnose failures in the electrical controls of heating, ventilation, and A/C (HVAC) systems; determine necessary action.	2	IR	PR
2. Inspect and test A/C-heater blower, motors, resistors, switches, relays, wiring, and protection devices; perform necessary action.	2	IR	PR
3. Test A/C compressor load cut-off systems; determine necessary action.	3	I	P
4. Diagnose failures in the vacuum and mechanical components and controls of the heating, ventilation, and A/C (HVAC) system; determine necessary action.	2	IR	PR
5. Inspect and test A/C-heater control panel assembly; determine necessary action.	3	IR	PR

Task		P	12	AD
6.	Inspect and test A/C-heater control cables and linkages; perform necessary action.	3	IR	PR
7.	Inspect and test A/C-heater ducts, doors, hoses, and outlets; perform necessary action.	3	IR	PR
8.	Check operation of automatic and semi-automatic heating, ventilation, and air-conditioning (HVAC) control systems; determine necessary action.	3	I	IR
E.	**Refrigerant Recovery, Recycling, and Handling**			
1.	Verify correct operation and maintenance of refrigerant handling equipment.	1	P	
2.	Identify (by label application or use of a refrigerant identifier) and recover A/C system refrigerant.	1	P	
3.	Recycle refrigerant.	1	P	
4.	Label and store refrigerant.	1	P	
5.	Test recycled refrigerant for non-condensable gases.	1	P	
6.	Evacuate and charge A/C system.	1	P	

AREA 8: ENGINE PERFORMANCE

For every task in Engine Performance, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task		P	12	AD
A.	**General Engine Diagnosis**			
1.	Interpret and verify concern; determine necessary action.	1	I	P
2.	Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.	2	P	R
3.	Diagnose unusual engine noise or vibration concerns; determine necessary action.	2	I	P
4.	Diagnose unusual exhaust color, odor, and sound; determine necessary action.	2	P	PR
5.	Perform engine absolute (vacuum/boost) manifold pressure tests; determine necessary action.	1	P	R
6.	Perform cylinder power balance test; determine necessary action.	1	P	
7.	Perform cylinder compression test; determine necessary action.	1	P	
8.	Perform cylinder leakage test; determine necessary action.	1	P	
9.	Diagnose engine mechanical, electrical, electronic, fuel, and ignition concerns with an oscilloscope and engine diagnostic equipment; determine necessary action.	1	I	P
10.	Prepare 4 or 5 gas analyzer; inspect and prepare vehicle for test, and obtain exhaust readings; interpret readings, and determine necessary action.	1	I	P

Task		P	12	AD
B.	**Computerized Engine Controls Diagnosis and Repair**			
1.	Retrieve and record stored OBD I diagnostic trouble codes; clear codes.	1	P	R
2.	Retrieve and record stored OBD II diagnostic trouble codes; clear codes.	3	P	R
3.	Diagnose the causes of emissions or driveability concerns resulting from failure of computerized engine controls with stored diagnostic trouble codes.	1	I	P
4.	Diagnose emissions or driveability concerns resulting from failure of computerized engine controls with no stored diagnostic trouble codes; determine necessary action.	1	I	P
5.	Inspect and test computerized engine control system sensors, powertrain control module (PCM), actuators, and circuits; perform necessary action.	2	I	P
6.	Obtain and interpret digital multimeter (DMM) readings.	1	P	R
7.	Access and use electronic service information (ESI).	3	P	R
8.	Locate and interpret vehicle and major component identification numbers (VIN, vehicle certification labels, and calibration decals).	1	P	
9.	Inspect and test power and ground circuits and connections; service or replace as needed.	1	P	R
10.	Practice recommended precautions when handling static sensitive devices.	2	P	R
11.	Diagnose driveability and emissions problems resulting from failures of interrelated systems (cruise control, security alarms, suspension controls, traction controls, A/C, automatic transmissions, non-OEM-installed accessories, and similar systems); determine necessary action.	2	I	P
C.	**Ignition System Diagnosis and Repair**			
1.	Diagnose no-starting, driveability, and emissions concerns on vehicles with electronic ignition (EI/DIS) (distributorless) systems; determine necessary action.	1	I	P
2.	Diagnose no-starting, driveability, and emissions concerns on	1	I	P

Task	P	12	AD
vehicles with distributor ignition (DI) systems; determine necessary action.			
3. Inspect and test ignition primary circuit wiring and components; perform necessary action.	2	P	R
4. Inspect and test distributor; perform necessary action.	3	P	PR
5. Inspect and test ignition system secondary circuit wiring and components; perform necessary action.	2	P	R
6. Inspect and test ignition coil(s); perform necessary action.	2	P	R
7. Check and adjust (where applicable) ignition system timing and timing advance/retard.	1	P	
8. Inspect and test ignition system pick-up sensor or triggering devices; perform necessary action.	2	IR	PR
9. Inspect and test ignition control module; perform necessary action.	2	IR	PR
D. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair			
1. Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems on vehicles with carburetor-type fuel systems; determine necessary action.	3	I	P
2. Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems on vehicles with injection-type fuel systems; determine necessary action.	1	I	P
3. Inspect fuel tank and fuel cap, fuel lines, fittings, and hoses, perform necessary action.	2	P	PR
4. Check fuel for contaminants and quality; determine necessary action.	2	I	P
5. Inspect and test mechanical and electrical fuel pumps and pump control systems; perform necessary action.	2	IR	PR
6. Replace fuel filters.	1	P	
7. Inspect and test fuel pressure regulation system and components of injection-type fuel systems; perform necessary action.	1	I	P
8. Inspect and test cold enrichment system and components; perform necessary action.	3	I	P
9. Remove, service, and install throttle body; adjust related linkages.	2	P	R
10. Inspect, test, and clean fuel injectors.	2	IR	PR
11. Inspect throttle body mounting plates, air induction and filtration system, intake manifold, and gaskets; perform necessary action.	2	P	R
12. Check idle speed and fuel mixture.	2	P	PR
13. Adjust (**carborated**) idle speed and fuel mixture.	3	P	PR
14. Remove, inspect, and test vacuum and electrical circuits, components and connections of fuel system; perform necessary	2	I	P

Task	P	12	AD
action.			
15. Inspect exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shield(s); perform necessary action.	2	P	R
16. Perform exhaust system back-pressure test; determine necessary action.	1	I	
17. Test the operation of turbocharger/supercharger systems; determine necessary action.	3	I	P
E. Emissions Control Systems Diagnosis and Repair			
1. Positive Crankcase Ventilation			
1. Diagnose oil leaks, emissions, and driveability problems resulting from failure of the positive crankcase ventilation (PCV) system; determine necessary action.	1	P	R
2. Inspect and test positive crankcase ventilation (PCV) filter/breather cap, valve, tubes, orifices, and hoses; perform necessary action.	2	P	R
2. Exhaust Gas Recirculation			
1. Diagnose emissions and driveability problems caused by failure of the exhaust gas recirculation (EGR) system; determine necessary action.	1	I	P
2. Inspect and test valve, valve manifold, and exhaust passages of exhaust gas recirculation (EGR) systems; perform necessary action.	2	IR	PR
3. Inspect and test vacuum/pressure controls, filters, and hoses of exhaust gas recirculation (EGR) systems; perform necessary action.	2	I	P
4. Inspect and test electrical/electronic sensors, controls, and wiring of exhaust gas recirculation (EGR) systems; perform necessary action.	2	I	P
3. Exhaust Gas Treatment			
1. Diagnose emissions and driveability problems resulting from failure of the secondary air injection and catalytic converter systems; determine necessary action.	2	I	PR
2. Inspect and test mechanical components of secondary air injection systems; perform necessary action.	2	I	PR
3. Inspect and test electrical/electronically-operated components and circuits of air injection systems; perform necessary action.	2	I	P
4. Inspect and test components of catalytic converter systems; perform necessary action.	2	IR	PR
4. Intake Air Temperature Controls			
1. Diagnose emissions and driveability problems resulting from failure of the intake air temperature control system; determine necessary action.	3	I	PR
2. Inspect and test components of intake air temperature control system; perform necessary action.	3	I	PR

Task	P	12	AD
5. Early Fuel Evaporation (Intake Manifold Temperature) Controls			
1. Diagnose emissions and driveability problems resulting from failure of early fuel evaporation control system; determine necessary action.	3	I	PR
2. Inspect and test components of early fuel evaporation control system; perform necessary action.	3	I	PR
6. Evaporative Emissions Controls			
1. Diagnose emissions and driveability problems resulting from failure of evaporative emissions control system; determine necessary action.	2	I	P
2. Inspect and test components and hoses of evaporative emissions control system; perform necessary action.	2	IR	PR
F. Engine Related Service			
1. Adjust valves on engines with mechanical or hydraulic lifters.	1	P	
2. Verify correct camshaft timing; determine necessary action	1	P	
3. Verify engine operating temperature; determine necessary action.	1	P	
4. Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank, and hoses; perform necessary action.	1	P	
5. Inspect and test thermostat, by-pass, and housing; perform necessary action.	1	P	
6. Inspect and test mechanical/electrical fans, fan clutch, fan shroud/ducting, air dams, and fan control devices; perform necessary action.	2	IR	PR

AREA I: SUSPENSION AND STEERING

For every task in Suspension and Steering, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. Steering Systems Diagnosis and Repair			
1. Disable and enable supplemental restraint system (SRS) in accordance with manufacturer's procedures.	1	I	PR
2. Remove and replace steering wheel; center/time supplemental restraint system (SRS) coil in accordance with manufacturer's procedures.	1	I	P
3. Diagnose steering column noises, looseness, and binding concerns (including tilt mechanisms); determine necessary action.	3	IR	PR
4. Diagnose power steering gear (non-rack and pinion) binding, uneven turning effort, loosenesss, hard steering, and fluid leakage concerns; determine necessary action.	3	IR	PR
5. Diagnose power steering gear (rack and pinion) binding, uneven turning effort, looseness, hard steering, and fluid leakage concerns; determine necessary action.	3	IR	PR
6. Inspect steering shaft universal-joint(s), flexible coupling(s), collapsible column, lock cylinder mechanism, and steering wheel; perform necessary action.	2	IR	PR
7. Adjust manual or power non-rack and pinion worm bearing preload and sector lash.	3	I	P
8. Remove and replace manual or power rack and pinion steering gear; inspect mounting bushings and brackets.	2	P	
9. Disassemble, inspect, perform necessary action and reassemble rack and pinion steering gear.	3	I	R
10. Adjust manual or power rack and pinion steering gear.	3	I	
11. Inspect and replace manual or power rack and pinion steering gear inner tie rod ends (sockets) and bellows boots.	2	P	
12. Inspect power steering fluid levels and condition.	1	P	
13. Flush, fill, and bleed power steering system.	2	P	R
14. Diagnose power steering fluid leakage; determine necessary action.	2	P	
15. Remove, inspect, replace, and adjust power steering pump belt.	1	P	
16. Remove, inspect, and replace power steering pump, mounts, seals, and gaskets.	3	P	PR
17. Remove, inspect, and replace power steering pump pulley; check alignment.	3	P	R
18. Inspect and replace power steering hoses and fittings.	2	P	
19. Inspect and replace pitman arm, relay (centerlink/intermediate) rod, idler arm and mountings, and steering linkage damper.	3	P	R
20. Inspect, replace, and adjust tie rod ends (sockets), tie rod sleeves, and clamps.	2	P	

Task	P	12	AD
21. Diagnose and adjust components of electronically controlled steering systems; determine necessary action.	3	I	P
B. Suspension Systems Diagnosis and Repair			
4. Front Suspension			
1. Diagnose short and long arm suspension system noises, body sway, and uneven riding height concerns; determine necessary action.	1	I	P
2. Diagnose MacPherson strut suspension system noises, body sway, and uneven riding height concerns; determine necessary action.	1	I	P
3. Remove, inspect, and install upper and lower control arms, bushings, shafts, and rebound bumpers.	2	P	
4. Remove, inspect, install, and adjust strut (compression/tension) rods and bushings.	2	P	
5. Remove, inspect, and install upper and lower ball joints on short and long arm suspension systems.	2	P	
6. Remove, inspect, and install steering knuckle assemblies.	2	P	
7. Remove, inspect, and install short and long arm suspension system coil springs and spring insulators.	2	P	
8. Remove, inspect, install, and adjust suspension system torsion bars; inspect mounts.	3	P	R
9. Remove, inspect, and install stabilizer bar bushings, brackets, and links.	3	P	R
10. Remove, inspect, and install MacPherson strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount.	1	P	
11. Lubricate suspension and steering systems.	2	P	
5. Rear Suspension			
1. Remove, inspect, and install coil springs and spring insulators.	2	P	
2. Remove, inspect, and install transverse links, control arms, bushings, and mounts.	2	P	
3. Remove, inspect, and install leaf springs, leaf spring insulators (silencers), shackles, brackets, bushings, and mounts.	3	P	R
4. Remove, inspect, and install MacPherson strut cartridge or assembly, strut coil spring, and insulators (silencers).	2	P	
6. Miscellaneous Service			
1. Inspect, remove, and replace shock absorbers.	1	P	
2. Remove, inspect, and service or replace front and rear wheel bearings.	1	P	
3. Diagnose, inspect, adjust, repair or replace components of electronically controlled suspension systems.	2	I	P
C. Wheel Alignment Diagnosis, Adjustment, and Repair			
1. Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return concerns; determine necessary action.	1	I	P
2. Perform prealignment inspection; perform necessary action.	1	P	R
3. Measure vehicle riding height; determine necessary action.	1	P	R
4. Check and adjust front and rear wheel camber; perform necessary action.	1	P	R
5. Check and adjust caster; perform necessary action.	1	P	R
6. Check and adjust front wheel toe; adjust as needed.	1	P	R
7. Center steering wheel.	1	P	R
8. Check toe-out-on-turns (turning radius); determine necessary action.	2	IR	PR
9. Check SAI (steering axis inclination) and included angle; determine necessary action.	2	IR	PR
10. Check and adjust rear wheel toe.	2	IR	PR
11. Check rear wheel thrust angle; determine necessary action.	2	IR	PR
12. Check for front wheel setback; determine necessary action.	2	IR	PR
13. Check front cradle (subframe) alignment; determine necessary action.	3	P	R

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Task	P	12	AD
D. Wheel and Tire Diagnosis and Repair			
1. Diagnose tire wear patterns; determine necessary action.	1	P	
2. Inspect tires; check and adjust air pressure.	1	P	
3. Diagnose wheel/tire vibration, shimmy, and noise; determine necessary action.	2	P	
4. Rotate tires according to manufacturer's recommendations.	1	P	
5. Measure wheel, tire, axle, and hub runout; determine necessary action.	2	P	
6. Diagnose tire pull (lead) problem; determine necessary action.	2	P	
7. Balance wheel and tire assembly (static and dynamic).	1	P	
8. Dismount, inspect, repair, and remount tire on wheel.	2	P	
9. Reinstall wheel; torque lug nuts.	1	P	

AREA 2: BRAKES–Priority One (22)

Task	12	AD
\. Hydraulic System Diagnosis and Repair		
3. Remove, bench bleed, and reinstall master cylinder.	P	
4. Diagnose poor stopping, pulling or dragging concerns caused by problems in the hydraulic system; determine necessary action.	P	
7. Select, handle, store, and install brake fluids to proper level.	P	
11. Bleed (manual, pressure, vacuum or surge) brake system.	P	
B. Drum Brake Diagnosis and Repair		
1. Diagnose poor stopping, noise, pulling, grabbing, dragging or pedal pulsation concerns; determine necessary action.	P	
2. Remove, clean (using proper safety procedures), inspect, and measure brake drums; service or replace as needed.	P	
6. Pre-adjust brake shoes and parking brake before installing brake drums or drum/hub assemblies and wheel bearings.	P	
7. Install wheel, torque lug nuts, and make final checks and adjustments.	P	
C. Disc Brake Diagnosis and Repair		
1. Diagnose poor stopping, noise, puling, grabbing, dragging or pedal pulsation concerns; determine necessary action.	P	
2. Remove caliper assembly from mountings; clean and inspect for leaks and damage to caliper housing; determine necessary action.	P	
3. Clean and inspect caliper mounting and slides for wear and damage; determine necessary action.	P	
4. Remove, clean, and inspect pads and retaining hardware; determine necessary action.	P	
5. Disassemble and clean caliper assembly; inspect parts for wear, rust, scoring, and damage; replace seal, boot, and damaged or worn parts.	P	
6. Reassemble, lubricate, and reinstall caliper, pads, and related hardware; seat pads, and inspect for leaks.	P	
7. Clean, inspect, and measure rotor with a dial indicator and a micrometer; follow manufacturer's recommendations in determining need to machine or replace.	P	
8. Refinish rotor according to manufacturer's recommendations.	P	
10. Install wheel, torque lug nuts, and make final checks and adjustments.	P	
D. Power Assist Units Diagnosis and Repair (NONE)		
E. Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, Etc.) Diagnosis and Repair		
1. Diagnose wheel bearing noises, wheel shimmy, and vibration concerns; determine necessary action.	P	

Task	12	AD
2. Remove, clean, inspect, repack, and install wheel bearings and replace seals; install hub and adjust wheel bearings.	P	
4. Check parking brake operation; adjust as needed.	P	
6. Check operation of brake stop light system; adjust and service as needed.	P	
7. Replace wheel bearing and race.	P	
F. Anti-lock Brake System		
3. Diagnose anti-lock brake system (ABS) electronic control(s) and components using self-diagnosis and/or recommended test equipment; determine necessary action.	P	

AREA 2: BRAKES--Priority Two (14)

Task	12	AD
. Hydraulic System Diagnosis and Repair		
1. Measure and adjust pedal height.	P	
2. Check master cylinder for internal and external leaks and proper operation; determine necessary action.	P	
5. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging or wear; tighten loose fittings and supports; determine necessary action.	P	
6. Fabricate and install brake lines (double flare and ISO types); replace hoses, fittings, and supports as needed.	P	
B. Drum Brake Diagnosis and Repair		
3. Mount brake drum on lathe; machine braking surface.	P	
4. Remove, clean, and inspect brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble.	P	
5. Remove, Inspect, and install wheel cylinders.	P	
C. Disc Brake Diagnosis and Repair		
11. Remove and replace rotor.	P	
D. Power Assist Units Diagnosis and Repair		
1. Test pedal free travel with and without engine running; check power assist operation.	P	PR
2. Check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster.	P	
3. Inspect the vacuum-type power booster unit for vacuum leaks; inspect the check valve for proper operation; determine necessary action.	P	
E. Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, Etc.) Diagnosis and Repair		
3. Check parking brake cables and components for wear, rusting, binding, and corrosion; clean, lubricate, and replace as needed.	P	
F. Anti-lock Brake System		
1. Inspect and test anti-lock brake system (ABS) components; determine necessary action.	P	R
2. Diagnose poor stopping, wheel lock-up, abnormal pedal feel or pulsation, and noise concerns caused by the anti-lock brake system (ABS); determine necessary action.	P	R
4. Depressurize high-pressure components of the anti-lock brake system (ABS).	P	R
5. Bleed the anti-lock brake system's (ABS) front and rear hydraulic circuits.	P	R
7. Service, test, and adjust anti-lock brake system (ABS) speed sensors.	IR	PR

AREA 2: BRAKES--Priority Three (5)

Task	12	AD
. Hydraulic System Diagnosis and Repair		
8. Inspect, test, and replace metering (hold-off), proportioning (balance), pressure differential, and combination valves.	P	R
9. Inspect, test, replace, and adjust height (load) sensing proportioning valve	IR	PR
10. Inspect, test, and replace components of brake warning light system.	P	R
12. Flush hydraulic system.	P	
B. Drum Brake Diagnosis and Repair (NONE)		

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C. Disc Brake Diagnosis and Repair		
9. Adjust calipers with integrated parking brake system.	P	PR
D. Power Assist Units Diagnosis and Repair		
4. Inspect and test hydro-boost system and accumulator for leaks and proper operation; determine necessary action.	P	R
E. Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, Etc.) Diagnosis and Repair		
5. Check operation of parking brake indicator light system.	P	
F. Anti-lock Brake System		
6. Remove and install anti-lock brake system (ABS) electrical/electronic and hydraulic components.	I	P
8. Diagnose anti-lock brake system (ABS) braking concerns caused by vehicle modifications (tire size, curb height, final drive ratio, etc.).	I	**P**

AREA 3: ELECTRICAL/ELECTRONIC SYSTEMS

For every task in Electrical/Electronic Systems, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. General Electrical System Diagnosis			
1. Use wiring diagrams during diagnosis of electrical circuit problems.	1	P	
2. Check electrical circuits with a test light; determine necessary action.	2	P	R
3. Check voltage and voltage drop in electrical/electronic circuits using a digital multimeter (DMM); determine necessary action.	1	P	
4. Check current flow in electrical/electronic circuits and components using an ammeter; determine necessary action.	1	P	
5. Check continuity and resistances in electrical/electronic circuits and components with an ohmmeter; determine necessary action.	1	P	
6. Check electrical circuits using jumper wires; determine necessary action.	2	P	R
7. Locate shorts, grounds, opens, and resistance problems in electrical/electronic circuits; determine necessary action.	1	P	
8. Measure and diagnose the cause(s) of abnormal key-off battery drain; determine necessary action.	1	P	
9. Inspect and test fusible links, circuit breakers, and fuses; determine necessary action.	1	P	
10. Inspect and test switches, connectors, relays, and wires of electrical/electronic circuits; perform necessary action.	1	P	
11. Repair wiring harnesses and connectors.	1	P	
12. Perform solder repair of electrical wiring.	1	P	
B. Battery Diagnosis and Service			
1. Perform battery state-of-charge test; determine needed service.	1	P	
2. Perform battery capacity test; determine needed service.	1	P	
3. Maintain or restore electronic memory functions.	2	P	R
4. Inspect, clean, fill, and replace battery.	2	P	PR
5. Perform slow/fast battery charge.	2	P	PR
6. Inspect and clean battery cables, connectors, clamps, and hold-downs; repair or replace as needed.	1	P	
7. Start a vehicle using jumper cables and a battery or auxiliary power supply according to manufacturers recommended specifications.	1	P	
C. Starting System Diagnosis and Repair			
1. Perform starter current draw tests; determine necessary action.	1	P	
2. Perform starter circuit voltage drop tests; determine necessary action.	1	P	
3. Inspect and test starter relays and solenoids; replace as needed.	2	IR	PR
4. Remove and install starter.	2	P	

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Task	P	12	AD
5. Perform starter bench tests; determine necessary action.	3	IR	PR
6. Inspect and test switches, connectors, and wires of starter control circuits; perform necessary action.	2	P	R
7. Disassemble, clean, inspect, and test starter components; replace as needed.	3	IR	PR
D. Charging System Diagnosis and Repair			
1. Perform charging system output test; determine necessary action.	1	P	
2. Diagnose charging system for the cause of undercharge, no-charge, and overcharge conditions.	1	P	
3. Inspect and adjust generator (alternator) drive belts; replace as needed.	1	P	
4. Inspect and test voltage regulator/regulating circuit; perform necessary action.	2	P	R
5. Remove inspect, and install generator (alternator).	2	P	PR
6. Disassemble generator (alternator), clean, inspect, and test components; determine necessary action.	3	IR	PR
7. Perform charging circuit voltage drop tests; determine necessary action.	1	P	
E. Lighting Systems Diagnosis and Repair			
1. Diagnose the cause of brighter than normal, intermittent, dim, or no light operation; determine necessary action.	2	P	PR
2. Inspect, replace, and aim headlights and bulbs.	2	P	
3. Inspect and diagnose incorrect turn signal or hazard light operation; perform necessary action.	2	P	PR
F. Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair			
1. Inspect and test gauges and gauge sending units for cause of intermittent, high, low, or no gauge readings; determine necessary action.	2	I	P
2. Inspect and test connectors, wires, and printed circuit boards of gauge circuits; determine necessary action.	3	I	P
3. Diagnose the cause of incorrect operation of warning devices and other driver information systems; determine necessary action.	1	P	
4. Inspect and test sensors, connectors, and wires of electronic instrument circuits; determine necessary action.	3	I	P
G. Horn and Wiper/Washer Diagnosis and Repair			
1. Diagnose incorrect horn operation; perform necessary action.	3	P	R
2. Diagnose incorrect wiper operation; diagnose wiper speed control and park problems; perform necessary action.	3	IR	PR
3. Diagnose incorrect windshield washer operation; perform necessary action.	3	P	PR
H. Accessories Diagnosis and Repair			
1. Diagnose incorrect operation of motor-driven accessory circuits; determine necessary action.	2	I	P
2. Diagnose incorrect heated glass operation; determine necessary action.	3	P	PR
3. Diagnose incorrect electric lock operation; determine necessary action.	3	IR	PR
4. Diagnose incorrect operation of cruise control systems; repair as needed.	3	IR	PR
5. Diagnose supplemental restraint system (SRS) concerns; determine necessary action. (Note: Follow manufacturer's safety procedures to prevent accidental deployment.)	2	I	PR
6. Diagnose radio static and weak, intermittent, or no radio reception; determine necessary action.	3	I	P

AREA 4: ENGINE PERFORMANCE

For every task in Engine Performance, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. General Engine Diagnosis			
1. Interpret and verify concern; determine necessary action.	1	I	P
2. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.	2	P	R
3. Diagnose unusual engine noise or vibration concerns; determine necessary action.	2	I	P
4. Diagnose unusual exhaust color, odor, and sound; determine necessary action.	2	I	P
5. Perform engine absolute (vacuum/boost) manifold pressure tests; determine necessary action.	1	P	R
6. Perform cylinder power balance test; determine necessary action.	1	P	
7. Perform cylinder compression test; determine necessary action.	1	P	
8. Perform cylinder leakage test; determine necessary action.	1	P	
9. Diagnose engine mechanical, electrical, electronic, fuel, and ignition concerns with an oscilloscope and engine diagnostic equipment; determine necessary action.	1	I	P

Task	P	12	AD
10. Prepare 4 or 5 gas analyzer; inspect and prepare vehicle for test, and obtain exhaust readings; interpret readings, and determine necessary action.	I	I	P
B. Computerized Engine Controls Diagnosis and Repair			
1. Retrieve and record stored OBD I diagnostic trouble codes; clear codes.	I	P	R
2. Retrieve and record stored OBD II diagnostic trouble codes; clear codes.	3	P	R
3. Diagnose the causes of emissions or driveability concerns resulting from failure of computerized engine controls with stored diagnostic trouble codes.	I	I	P
4. Diagnose emissions or driveability concerns resulting from failure of computerized engine controls with no stored diagnostic trouble codes; determine necessary action.	I	I	P
5. Inspect and test computerized engine control system sensors, powertrain control module (PCM), actuators, and circuits; perform necessary action.	2	I	P
6. Obtain and interpret digital multimeter (DMM) readings.	I	P	R
7. Access and use electronic service information (ESI).	3	P	R
8. Locate and interpret vehicle and major component identification numbers (VIN, vehicle certification labels, and calibration decals).	I	P	
9. Inspect and test power and ground circuits and connections; service or replace as needed.	I	P	R
10. Practice recommended precautions when handling static sensitive devices.	2	P	R
11. Diagnose driveability and emissions problems resulting from failures of interrelated systems (cruise control, security alarms, suspension controls, traction controls, A/C, automatic transmissions, non-OEM-installed accessories, and similar systems); determine necessary action.	2	I	P

Task	P	12	AD
C. Ignition System Diagnosis and Repair			
1. Diagnose no-starting, driveability, and emissions concerns on vehicles with electronic ignition (EI/DIS) (distributorless) systems; determine necessary action.	1	I	P
2. Diagnose no-starting, driveability, and emissions concerns on vehicles with distributor ignition (DI) systems; determine necessary action.	1	I	P
3. Inspect and test ignition primary circuit wiring and components; perform necessary action.	2	P	R
4. Inspect and test distributor; perform necessary action.	3	P	PR
5. Inspect and test ignition system secondary circuit wiring and components; perform necessary action.	2	I	P
6. Inspect and test ignition coil(s); perform necessary action.	2	P	R
7. Check and adjust (where applicable) ignition system timing and timing advance/retard.	1	P	
8. Inspect and test ignition system pick-up sensor or triggering devices; perform necessary action.	2	IR	PR
9. Inspect and test ignition control module; perform necessary action.	2	IR	PR
D. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair			
1. Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems on vehicles with carburetor-type fuel systems; determine necessary action.	3	I	P
2. Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems on vehicles with injection-type fuel systems; determine necessary action.	1	I	P
3. Inspect fuel tank and fuel cap, fuel lines, fittings, and hoses, perform necessary action.	2	P	PR
4. Check fuel for contaminants and quality; determine necessary action.	2	I	P
5. Inspect and test mechanical and electrical fuel pumps and pump control systems; perform necessary action.	2	IR	PR
6. Replace fuel filters.	1	P	
7. Inspect and test fuel pressure regulation system and components of injection-type fuel systems; perform necessary action.	1	I	P
8. Inspect and test cold enrichment system and components; perform necessary action.	3	I	P
9. Remove, service, and install throttle body; adjust related linkages.	2	P	R
10. Inspect, test, and clean fuel injectors.	2	IR	PR
11. Inspect throttle body mounting plates, air induction and filtration system, intake manifold, and gaskets; perform necessary action.	2	P	R
12. Check idle speed and fuel mixture.	2	P	PR
13. Adjust **(carborated)** idle speed and fuel mixture.	3	I	P
14. Remove, inspect, and test vacuum and electrical circuits, components and connections of fuel system; perform necessary action.	2	I	P
15. Inspect exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shield(s); perform necessary action.	2	P	R
16. Perform exhaust system back-pressure test; determine necessary action.	1	I	
17. Test the operation of turbocharger/supercharger systems; determine necessary action.	3	I	P
E. Emissions Control Systems Diagnosis and Repair			
1. Positive Crankcase Ventilation			
1. Diagnose oil leaks, emissions, and driveability problems resulting from failure of the positive crankcase ventilation (PCV) system; determine necessary	1	P	R

Task	P	12	AD
action.			
2. Inspect and test positive crankcase ventilation (PCV) filter/breather cap, valve, tubes, orifices, and hoses; perform necessary action.	2	P	R
2. Exhaust Gas Recirculation			
1. Diagnose emissions and driveability problems caused by failure of the exhaust gas recirculation (EGR) system; determine necessary action.	1	I	P
2. Inspect and test valve, valve manifold, and exhaust passages of exhaust gas recirculation (EGR) systems; perform necessary action.	2	IR	PR
3. Inspect and test vacuum/pressure controls, filters, and hoses of exhaust gas recirculation (EGR) systems; perform necessary action.	2	I	P
4. Inspect and test electrical/electronic sensors, controls, and wiring of exhaust gas recirculation (EGR) systems; perform necessary action.	2	I	P
3. Exhaust Gas Treatment			
1. Diagnose emissions and driveability problems resulting from failure of the secondary air injection and catalytic converter systems; determine necessary action.	2	I	PR
2. Inspect and test mechanical components of secondary air injection systems; perform necessary action.	2	I	PR
3. Inspect and test electrical/electronically-operated components and circuits of air injection systems; perform necessary action.	2	I	P
4. Inspect and test components of catalytic converter systems; perform necessary action.	2	IR	PR
4. Intake Air Temperature Controls			
1. Diagnose emissions and driveability problems resulting from failure of the intake air temperature control system; determine necessary action.	3	I	PR
2. Inspect and test components of intake air temperature control system; perform necessary action.	3	I	PR
5. Early Fuel Evaporation (Intake Manifold Temperature) Controls			
1. Diagnose emissions and driveability problems resulting from failure of early fuel evaporation control system; determine necessary action.	3	I	PR
2. Inspect and test components of early fuel evaporation control system; perform necessary action.	3	I	PR
6. Evaporative Emissions Controls			
1. Diagnose emissions and driveability problems resulting from failure of evaporative emissions control system; determine necessary action.	2	I	P
2. Inspect and test components and hoses of evaporative emissions control system; perform necessary action.	2	IR	PR
F. Engine Related Service			
1. Adjust valves on engines with mechanical or hydraulic lifters.	1	P	
2. Verify correct camshaft timing; determine necessary action.	1	P	
3. Verify engine operating temperature; determine necessary action.	1	P	
4. Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank, and hoses; perform necessary action.	1	P	
5. Inspect and test thermostat, by-pass, and housing; perform necessary action.	1	P	
6. Inspect and test mechanical/electrical fans, fan clutch, fan shroud/ducting, air dams, and fan control devices; perform necessary action.	2	IR	PR

AREA 5: ENGINE REPAIR

For every task in Engine Repair, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
B. General Engine Diagnosis; Removal and Reinstallation (R & R)			
* 1. Verify and interpret engine concern; determine necessary action.	1	IR	PR
2. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.	2	P	R
3. Diagnose engine noises and vibrations; determine necessary action.	3	IR	PR
4. Diagnose the cause of excessive oil consumption, unusual engine exhaust color, odor, and sound; determine necessary action.	3	IR	PR
5. Perform engine vacuum tests; determine necessary action.	1	P	
6. Perform cylinder power balance tests; determine necessary action.	1	P	
7. Perform cylinder compression tests; determine necessary action.	1	P	
8. Perform cylinder leakage tests; determine necessary action.	1	P	
9. Remove engine (front-wheel drive); prepare for disassembly.	3	IR	PR
10. Reinstall engine (front-wheel drive).	3	IR	PR
11. Remove engine (rear-wheel drive); prepare for disassembly.	3	IR	PR
12. Reinstall engine (rear-wheel drive).	3	IR	PR
B. Cylinder Head and Valve Train Diagnosis and Repair			
1. Remove cylinder head(s); visually inspect cylinder head(s) for cracks; check gasket surface areas for warpage and leakage; check passage condition.	2	P	R
2. Install cylinder heads and gaskets; tighten according to manufacturer's specifications and procedures.	2	P	R
3. Inspect and test valve springs for squareness, pressure, and free height comparison; replace as needed.	3	I	P
4. Inspect value spring retainers, locks, and valve grooves.	2	P	PR
5. Replace valve stem seals.	3	IR	PR
6. Inspect valve guides for wear; check valve guide height and stem-to-guide clearance; recondition or replace as needed.	3	IR	PR
7. Resurface values; perform necessary action.	2	IR	PR
8. Resurface valve seats; perform necessary action.	2	IR	PR
9. Check valve face-to-seat contact and valve seat concentricity (runout); service seats and valves as needed.	3	IR	PR
10. Check valve spring assembled height and valve stem height; service valve and spring assemblies as needed.	2	IR	PR
11. Inspect pushrods, rocker arms, rocker arm pivots and shafts for wear, bending, cracks, looseness, and blocked oil passages (orifices); perform necessary action.	2	IR	PR
12. Inspect hydraulic or mechanical lifters; replace as needed.	2	IR	PR
13. Adjust valves (mechanical or hydraulic lifters).	1	P	
14. Inspect camshaft drives (including gear wear and backlash, sprocket and chain wear); replace as necessary.	2	IR	PR
* 15. Inspect and replace timing belt(s), overhead camdrive sprockets, and	1	P	

Task	P	12	AD
tensioners; check belt tension; adjust as necessary.			
16. Inspect camshaft for runout, journal wear and lobe wear.	3	IR	PR
17. Inspect and measure camshaft bearing for wear, damage, out-of-round, and alignment; determine necessary action.	3	IR	PR
18. Verify camshaft(s) timing according to manufacturer's specifications and procedure.	1	P	
C. Engine Block Assembly Diagnosis and Repair			
* 1. Inspect and replace pans, covers, gaskets, and seals.	2	P	PR
2. Inspect engine block for visible cracks, passage condition, core and gallery plug condition, and surface warpage; determine necessary action.	2	P	PR
* 3. Inspect internal and external threads; restore as needed (includes installing thread inserts).	1	P	
4. Remove cylinder wall ridges.	3	P	R
5. Inspect and measure cylinder walls for damage and wear; determine necessary action.	2	IR	PR
6. Deglaze and clean cylinder walls.	1	P	
7. Inspect and measure camshaft bearings for wear, damage, out-of-round, and alignment; determine necessary action.	3	IR	PR
8. Inspect crankshaft for surface cracks and journal damage; check oil passage condition; measure journal wear; determine necessary action.	3	IR	PR
9. Inspect and measure main and connecting rod bearings for damage, clearance, and end play; determine necessary action (includes the proper selection of bearings).	2	IR	PR
10. Identify piston and bearing wear patterns that indicate connecting rod alignment and main bearing bore problems; inspect rod alignment and bearing bore condition.	3	IR	PR
11. Inspect, measure, and service pistons and pins; determine necessary action.	2	IR	PR
12. Inspect, measure, and install piston rings.	2	IR	PR
13. Inspect, repair or replace crankshaft vibration damper (harmonic balancer).	3	P	PR
* 14. Reassemble engine components using correct gaskets and sealants.	2	P	R
15. Inspect auxiliary (balance, intermediate, idler, counterbalance or silencer) shaft(s); inspect shaft(s) and support bearing for damage and wear; determine necessary action; reinstall and time.	3	I	P
16. Prime engine lubrication system.	1	IR	PR
D. Lubrication and Cooling Systems Diagnosis and Repair			
* 1. Perform oil pressure tests; determine necessary action.	1	P	
2. Inspect oil pump gears or rotors, housing, pressure relief devices, and pump drive; perform necessary action.	3	IR	PR
3. Perform cooling system, cap, and recovery system tests (pressure, combustion leakage, and temperature); determine necessary action.	1	P	
4. Inspect, replace, and adjust drive belts, tensioners, and pulleys.	1	P	
* 5. Inspect and replace engine cooling and heater system hoses.	2	P	PR
6. Inspect, test, and replace thermostat and housing.	2	P	PR
* 7. Test coolant; drain and recover coolant; flush and refill cooling system with recommended coolant; bleed air as required.	1	P	
* 8. Inspect, test, remove, and replace water pump.	2	IR	PR
* 9. Remove and replace radiator.	2	IR	PR
* 10. Inspect, and test fan(s) (electrical or mechanical), fan clutch, fan shroud, and air dams.	2	IR	PR
11. Inspect auxiliary oil coolers; replace as needed.	3	P	PR
* 12. Inspect, test, and replace oil temperature and pressure switches and sensors.	2	IR	PR
13. Perform oil and filter change.	1	P	

*

AREA 6: AUTOMATIC TRANSMISSION AND TRANSAXLE

For every task in Automatic Transmission and Transaxle, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. General Transmission and Transaxle Diagnosis			
1. Identify and interpret transmission concern; assure proper engine operation; determine necessary action.	1	1	P
* 2. Diagnose unusual fluid usage, level, and condition concerns; determine necessary action.	1	1	P
3. Perform pressure tests; determine necessary action.	1		P
4. Perform lock-up converter system tests; determine necessary action.	2		P
5. Diagnose electronic, mechanical, hydraulic, vacuum control system concerns; determine necessary action.	1	1	P
6. Diagnose noise and vibration concerns; determine necessary action.	3		P
B. Transmission and Transaxle Maintenance and Adjustment			
* 1. Inspect, adjust or replace throttle (TV) linkages or cables, check gear select indicator (as applicable).	1	1	P
* 2. Service transmission; perform visual inspection; replace fluids and filters.	1	P	PR
C. In-Vehicle Transmission and Transaxle Repair			
1. Inspect, adjust or replace (as applicable) vacuum modulator; inspect and repair or replace lines and hoses.	3	IR	P
2. Inspect, repair, and replace governor assembly.	3	P	PR
* 3. Inspect and replace external seals and gaskets.	2	I	P
4. Inspect extension housing, bushings and seals; perform necessary action.	3	IR	P
5. Inspect, leak test, flush, and replace cooler, lines, and fittings.	1	P	PR
* 6. Inspect and replace speedometer drive gear, driven gear, vehicle speed sensor (VSS), and retainers.	3	IR	P
7. Inspect and test, adjust, repair or replace transmission related electrical and electronic components (includes computers, solenoids, sensors, relays, switches, and harnesses).	1	1	P
* 8. Inspect, replace, and align powertrain mounts.	3	P	PR
D. Off-Vehicle Transmission and Transaxle Repair			
5. Removal, Disassembly, and Reinstallation			
1. Remove and reinstall transmission and torque converter (rear-wheel drive).	2	IR	P
2. Remove and reinstall transaxle and torque converter assembly.	2	IR	P
3. Disassemble, clean, and inspect transmission/transaxle.	1		P
4. Inspect, measure, clean, and replace valve body (includes surfaces and bores, springs, valves, sleeves, retainers, brackets, check-balls, screens, spacers, and gaskets), and torque valve body bolts.	2		P
5. Inspect servo bore, piston, seals, pin, spring, and retainers; determine necessary action.	3		P
6. Inspect accumulator bore, piston, seals, spring, and retainer; determine necessary action.	3		P
7. Assemble transmission/transaxle.	1		P
6. Oil Pump and Converter			

Task	P	12	AD
1. Inspect converter flex plate, attaching parts, pilot, pump drive, and seal areas.	2	IR	P
2. Measure torque converter endplay and check for interference; check stator clutch.	2		P
3. Inspect, measure, and replace oil pump assembly and components.	3		P
4. Check torque converter and transmission cooling system for contamination.	1		P
7. Gear Train, Shafts, Bushings and Case			
1. Measure endplay or preload; determine necessary action.	1		P
2. Inspect, measure, and replace thrust washers and bearings.	2		P
3. Inspect oil delivery seal rings, ring grooves, and sealing surface areas.	2		P
4. Inspect bushings; replace as needed.	2		P
5. Inspect and measure planetary gear assembly (includes sun, ring gear, thrust washers, planetary gears, and carrier assembly); replace as needed.	2		P
6. Inspect case bores, passages, bushings, vents, and mating surfaces; determine necessary action.	2		P
7. Inspect transaxle drive, link chains, sprockets, gears, bearings, and bushings; perform necessary action.	2		P
8. Inspect, measure, repair, adjust or replace transaxle final drive components.	2		P
9. Inspect and reinstall parking pawl, shaft, spring, and retainer; determine necessary action.	3		P
8. Friction and Reaction Units			
1. Inspect clutch drum, piston, check-balls, springs, retainers, seals, and friction and pressure plates; replace as needed.	2		P
2. Measure clutch pack clearance; adjust as needed.	1		P
3. Air test operation of clutch and servo assemblies.	1		P
4. Inspect roller and sprag clutch, races, rollers, sprags, springs, cages, and retainers; replace as needed.	2		P
5. Inspect bands and drums; adjust or replace as needed.	3		P

AREA 7: MANUAL DRIVE TRAIN AND AXLES

For every task in Manual Drive Train and Axles, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. Clutch Diagnosis and Repair			
1. Diagnose clutch noise, binding, slippage, pulsation, and chatter; determine necessary action.	1	I	P
2. Inspect clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs; perform necessary action.	1	I	P
3. Inspect hydraulic clutch slave and master cylinders, lines, and hoses; perform necessary action.	1	I	P
4. Inspect release (throw-out) bearing, lever, and pivot; perform necessary action.	1	I	P
5. Inspect and replace clutch pressure plate assembly and clutch disc.	1	IR	P
6. Inspect, remove or replace crankshaft pilot bearing or bushing (as applicable).	1	IR	P
7. Inspect flywheel and ring gear for wear and cracks, measure runout; determine necessary action.	1	IR	P
8. Inspect engine block, clutch (bell) housing, and transmission/transaxle case mating surfaces; determine necessary action.	3	IR	PR
9. Measure flywheel-to-block runout and crankshaft endplay; determine necessary action.	3	IR	PR
B. Transmission/Transaxle Diagnosis and Repair			
1. Remove and reinstall transmission/transaxle.	2	IR	PR
2. Disassemble, clean, and reassemble transmission/transaxle components.	2	I	PR
3. Inspect transmission/transaxle case, extension housing, case mating surfaces, bores, bushings, and vents; perform necessary action.	3		P
4. Diagnose noise, hard shifting, jumping out of gear, and fluid leakage concerns; determine necessary action.	3	I	PR
5. Inspect, adjust, and reinstall shift linkages, brackets, bushings, cables, pivots, and levers.	3	IR	PR
6. Inspect and reinstall powertrain mounts.	3	P	PR
7. Inspect and replace gaskets, seals, and sealants; inspect sealing surfaces.	2	IR	PR
8. Remove and replace transaxle final drive.	3	I	PR
9. Inspect, adjust, and reinstall shift cover, forks, levers, grommets, shafts, sleeves, detent mechanism, interlocks, and springs.	2	I	PR
10. Measure endplay or preload (shim or spacer selection procedure) on transmission/transaxle shafts; perform necessary action.	1		P
11. Inspect and reinstall synchronizer hub, sleeve, keys (inserts), springs, and blocking rings.	2	I	PR
12. Inspect and reinstall speedometer drive gear, driven gear, vehicle speed sensor (VSS), and retainers.	2	IR	PR
13. Diagnose transaxle final drive assembly noise and vibration concerns;	3		P

Task	P	12	AD
determine necessary action.			
14. Remove, inspect, measure, adjust, and reinstall transaxle final drive pinion gears (spiders), shaft, side gears, side bearings, thrust washers, and case assembly.	2	I	PR
15. Inspect lubrication devices (oil pump or slingers); perform necessary action.	3		P
16. Inspect, test, and replace transmission/transaxle sensors and switches.	1	I	P
C. Drive Shaft and Half Shaft, Universal and Constant-Velocity (CV) Joint Diagnosis and Repair			
1. Diagnose constant-velocity (CV) joint noise and vibration concerns; determine necessary action.	2	IR	PR
2. Diagnose universal joint noise and vibration concerns; perform necessary action.	2	IR	PR
3. Replace front wheel drive (FWD) front wheel bearing.	2	I	PR
* 4. Inspect, service, and replace shafts, yokes, boots, and CV joints.	1	P	PR
5. Inspect, service, and replace shaft center support bearings.	3	IR	P
6. Check shaft balance; measure shaft runout; measure and adjust driveline angles.	3	I	P
D. Drive Axle Diagnosis and Repair			
4. Ring and Pinion Gears and Differential Case Assembly			
1. Diagnose noise and vibration concerns; determine necessary action.	2	I	PR
2. Diagnose fluid leakage concerns; determine necessary action.	2	P	PR
* 3. Inspect and replace companion flange and pinion seal; measure companion flange runout.	2	I	PR
4. Inspect ring gear and measure runout; determine necessary action.	2	I	PR
5. Remove, inspect, and reinstall drive pinion and ring gear, spacers, sleeves, and bearings.	2	I	PR
6. Measure and adjust drive pinion depth.	2	I	PR
7. Measure and adjust drive pinion bearing preload.	1	I	P
8. Measure and adjust side bearing preload and ring and pinion gear total backlash and backlash variation on a differential carrier assembly (threaded cup or shim types).	2	I	PR
9. Check ring and pinion tooth contact patterns; perform necessary action.	1	I	P
10. Disassemble, inspect, measure, and adjust or replace differential pinion gears (spiders), shaft side gears, side bearings, thrust washers, and case.	2	I	PR
11. Reassemble and reinstall differential case assembly; measure runout; determine necessary action.	2	I	PR
5. Limited Slip Differential			
1. Diagnose noise, slippage, and chatter concerns; determine necessary action.	3	I	PR
* 2. Inspect and flush differential housing; refill with correct lubricant.	2	P	PR
3. Inspect and reinstall clutch (cone or plate) components.	3		P
4. Measure rotating torque; determine necessary action.	3		P
6. Drive Axle Shaft			
1. Diagnose drive axle shafts, bearings, and seals for noise, vibration, and fluid leakage concerns; determine necessary action.	2	I	PR
* 2. Inspect and replace drive axle shaft wheel studs.	3	P	PR
* 3. Remove and replace drive axle shafts.	1	P	PR
4. Inspect and replace drive axle shaft seals, bearings, and retainers.	2	I	PR
5. Measure drive axle flange runout and shaft endplay; determine necessary action.	2	I	PR
E. Four-wheel Drive/All-wheel Drive Component Diagnosis and Repair			
1. Diagnose noise, vibration, and unusual steering concerns; determine necessary action.	3		P

Task	P	12	AD
2. Inspect, adjust, and repair shifting controls (mechanical, electrical, and vacuum), bushings, mounts, levers, and brackets.	3		P
3. Remove and reinstall transfer case.	3		P
4. Disassemble, service, and reassemble transfer case and components.	3		P
5. Inspect front-wheel bearings and locking hubs; perform necessary action.	3		P
6. Check drive assembly seals and vents; check lube level.	3	P	PR
* 7. Diagnose test, adjust, and replace electrical/electronic components of four-wheel drive systems.	3		P

AREA 8: HEATING AND AIR CONDITIONING

For every task in Heating and Air Conditioning, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

Task	P	12	AD
A. A/C System Diagnosis and Repair			
1. Diagnose unusual operating noises in the A/C system; determine necessary action.	2	I	PR
* 2. Identify refrigerant type; conduct a performance test of the A/C system; determine necessary action.	1	I	P
* 3. Leak test A/C system; determine necessary action.	1	I	P
4. Inspect the condition of discharged oil; determine necessary action.	2	I	P
5. Select oil type; measure, and add oil to the A/C system as needed.	2	P	PR
B. Refrigeration System Component Diagnosis and Repair			
1. Compressor and Clutch			
1. Diagnose A/C system conditions that cause the protection devices (pressure, thermal, and PCM) to interrupt system operation; determine necessary action.	2	I	P
* 2. Inspect A/C compressor drive belts; replace and adjust as needed.	2	P	R
3. Inspect, test, and replace A/C compressor clutch components or assembly.	2	P	R
4. Remove and replace A/C compressor and mountings.	2	P	R
3. Evaporator, Condenser, and Related Components			
1. Determine need for A/C system filter; perform necessary action.	3	P	PR
2. Remove and inspect A/C system mufflers, hoses, lines, fittings, o-rings, seals, and service valves; perform necessary action.	2	P	R
* 3. Inspect A/C condenser for airflow restrictions; perform necessary action.	1	P	R
4. Remove and install receiver/drier or accumulator/drier.	2	P	R
5. Remove and install expansion valve or orifice (expansion) tube.	2	P	R
6. Inspect evaporator housing water drain; perform necessary action.	3	P	R
C. Heating, Ventilation, and Engine Cooling Systems Diagnosis and Repair			
1. Diagnose temperature control problems in the heater/ventilation system; determine necessary action.	2	IR	PR
2. Perform cooling system, cap, and recovery system tests (pressure, combustion leakage, and temperature); determine necessary action.	1	P	
* 3. Inspect engine cooling and heater system hoses and belts; perform necessary action.	1	P	
4. Inspect, test, and replace thermostat and housing.	1	P	
5. Determine coolant condition; drain and recover coolant.	1	P	

Task	P	12	AD
6. Flush system; refill system with recommended coolant; bleed system.	1	P	
7. Inspect and test fan, fan clutch (electrical and mechanical), fan shroud, and air dams; perform necessary action.	1	P	PR
8. Inspect and test electrical fan control system and circuits.	1	I	PR
9. Inspect and test heater control valve(s); perform necessary action.	2	P	R
D. Operating Systems and Related Controls Diagnosis and Repair			
1. Diagnose failures in the electrical controls of heating, ventilation, and A/C (HVAC) systems; determine necessary action.	2	IR	PR
2. Inspect and test A/C-heater blower, motors, resistors, switches, relays, wiring, and protection devices; perform necessary action.	2	IR	PR
3. Test A/C compressor load cut-off systems; determine necessary action.	3	I	P
4. Diagnose failures in the vacuum and mechanical components and controls of the heating, ventilation, and A/C (HVAC) system; determine necessary action.	2	IR	PR
5. Inspect and test A/C-heater control panel assembly; determine necessary action.	3	IR	PR
6. Inspect and test A/C-heater control cables and linkages; perform necessary action.	3	IR	PR
7. Inspect and test A/C-heater ducts, doors, hoses, and outlets; perform necessary action.	3	IR	PR
8. Check operation of automatic and semi-automatic heating, ventilation, and air-conditioning (HVAC) control systems; determine necessary action.	3	I	IR
E. Refrigerant Recovery, Recycling, and Handling			
* 1. Verify correct operation and maintenance of refrigerant handling equipment.	1	P	

Task	P	12	AD
* 2. Identify (by label application or use of a refrigerant identifier) and recover * A/C system refrigerant.	I	P	
3. Recycle refrigerant. *	I	P	
4. Label and store refrigerant.	I	P	
* 5. Test recycled refrigerant for non-condensable gases.	I	P	
* 6. Evacuate and charge A/C system.	I	P	

AREA 1: SUSPENSION AND STEERING–Priority One (20)

Task	12	AD
A. Steering Systems Diagnosis and Repair		
1. Disable and enable supplemental restraint system (SRS) in accordance with manufacturer's procedures.	I	PR
2. Remove and replace steering wheel; center/time supplemental restraint system (SRS) coil in accordance with manufacturer's procedures.	I	P
12. Inspect power steering fluid levels and condition.	P	
15. Remove, inspect, replace, and adjust power steering pump belt.	P	
B. Suspension Systems Diagnosis and Repair		
1. Front Suspension		
1. Diagnose short and long arm suspension system noises, body sway, and uneven riding height concerns; determine necessary action.	I	P
2. Diagnose MacPherson strut suspension system noises, body sway, and uneven riding height concerns; determine necessary action.	I	P
10. Remove, inspect, and install MacPherson strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount.	*P*	
2. Rear Suspension(NONE)		
3. Miscellaneous Service		
1. Inspect, remove, and replace shock absorbers.	*P*	
2. Remove, inspect, and service or replace front and rear wheel bearings.	P	
C. Wheel Alignment Diagnosis, Adjustment, and Repair		
1. Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return concerns; determine necessary action.	I	P
2. Perform prealignment inspection; perform necessary action.	P	R
3. Measure vehicle riding height; determine necessary action.	P	R
4. Check and adjust front and rear wheel camber; perform necessary action.	P	R
5. Check and adjust caster; perform necessary action.	P	R
6. Check and adjust front wheel toe; adjust as needed.	P	R
7. Center steering wheel.	P	R
D. Wheel and Tire Diagnosis and Repair		
1. Diagnose tire wear patterns; determine necessary action.	*P*	
2. Inspect tires; check and adjust air pressure.	P	
4. Rotate tires according to manufacturer's recommendations.	P	
7. Balance wheel and tire assembly (static and dynamic).	P	

Task	**12**	**AD**
9. Reinstall wheel; torque lug nuts.	P	

AREA 1: SUSPENSION AND STEERING–Priority Two (21)

Task	12	AD
A. Steering Systems Diagnosis and Repair		
6. Inspect steering shaft universal-joint(s), flexible coupling(s), collapsible column, lock cylinder mechanism, and steering wheel; perform necessary action.	IR	PR
8. Remove and replace manual or power rack and pinion steering gear; inspect mounting bushings and brackets.	P	
11. Inspect and replace manual or power rack and pinion steering gear inner tie rod ends (sockets) and bellows boots.	P	
13. Flush, fill, and bleed power steering system.	P	*R*
14. Diagnose power steering fluid leakage; determine necessary action.	P	
18. Inspect and replace power steering hoses and fittings.	P	
20. Inspect, replace, and adjust tie rod ends (sockets), tie rod sleeves, and clamps.	P	
B. Suspension Systems Diagnosis and Repair		
1. Front Suspension		
3. Remove, inspect, and install upper and lower control arms, bushings, shafts, and rebound bumpers.	P	
4. Remove, inspect, install, and adjust strut (compression/tension) rods and bushings.	P	
5. Remove, inspect, and install upper and lower ball joints on short and long arm suspension systems.	P	
6. Remove, inspect, and install steering knuckle assemblies.	P	
7. Remove, inspect, and install short and long arm suspension system coil springs and spring insulators.	P	
11. Lubricate suspension and steering systems.	P	
2. Rear Suspension		
1. Remove, inspect, and install coil springs and spring insulators.	P	
2. Remove, inspect, and install transverse links, control arms, bushings, and mounts.	P	
4. Remove, inspect, and install MacPherson strut cartridge or assembly, strut coil spring, and insulators (silencers).	P	
3. Miscellaneous Service		
3. Diagnose, inspect, adjust, repair or replace components of electronically controlled suspension systems.	I	P
C. Wheel Alignment Diagnosis, Adjustment, and Repair		
8. Check toe-out-on-turns (turning radius); determine necessary action.	IR	PR
9. Check SAI (steering axis inclination) and included angle; determine necessary action.	IR	PR
10. Check and adjust rear wheel toe.	IR	PR
11. Check rear wheel thrust angle; determine necessary action.	IR	PR
12. Check for front wheel setback; determine necessary action.	IR	PR

Task	12	AD
D. Wheel and Tire Diagnosis and Repair		
3. Diagnose wheel/tire vibration, shimmy, and noise; determine necessary action.	P	
5. Measure wheel, tire, axle, and hub runout; determine necessary action.	P	
6. Diagnose tire pull (lead) problem; determine necessary action.	P	
8. Dismount, inspect, repair, and remount tire on wheel.	P	

AREA 1: SUSPENSION AND STEERING–Priority Three (7)

Task	12	AD
A. Steering Systems Diagnosis and Repair		
3. Diagnose steering column noises, looseness, and binding concerns (including tilt mechanisms); determine necessary action.	IR	PR
4. Diagnose power steering gear (non-rack and pinion) binding, uneven turning effort, loosenesss, hard steering, and fluid leakage concerns; determine necessary action.	IR	PR
5. Diagnose power steering gear (rack and pinion) binding, uneven turning effort, looseness, hard steering, and fluid leakage concerns; determine necessary action.	IR	PR
7. Adjust manual or power non-rack and pinion worm bearing preload and sector lash.	I	P
9. Disassemble, inspect, perform necessary action and reassemble rack and pinion steering gear.	I	R
10. Adjust manual or power rack and pinion steering gear.	I	
16. Remove, inspect, and replace power steering pump, mounts, seals, and gaskets.	P	PR
17. Remove, inspect, and replace power steering pump pulley; check alignment.	P	R
19. Inspect and replace pitman arm, relay (centerlink/intermediate) rod, idler arm and mountings, and steering linkage damper.	P	R
21. Diagnose and adjust components of electronically controlled steering systems; determine necessary action.	I	P
B. Suspension Systems Diagnosis and Repair		
1. Front Suspension		
8. Remove, inspect, install, and adjust suspension system torsion bars; inspect mounts.	P	R
9. Remove, inspect, and install stabilizer bar bushings, brackets, and links.	P	R
2. Rear Suspension		
3. Remove, inspect, and install leaf springs, leaf spring insulators (silencers), shackles, brackets, bushings, and mounts.	P	R
3. Miscellaneous Service (NONE)		
C. Wheel Alignment Diagnosis, Adjustment, and Repair		
13. Check front cradle (subframe) alignment; determine necessary action.	P	R
D. Wheel and Tire Diagnosis and Repair (NONE)		

AREA 2: BRAKES--Priority One (22)

Task	12	AD
A. Hydraulic System Diagnosis and Repair		
3. Remove, bench bleed, and reinstall master cylinder.	P	
4. Diagnose poor stopping, pulling or dragging concerns caused by problems in the hydraulic system; determine necessary action.	P	
7. Select, handle, store, and install brake fluids to proper level.	P	
11. Bleed (manual, pressure, vacuum or surge) brake system.	P	
B. Drum Brake Diagnosis and Repair		
1. Diagnose poor stopping, noise, pulling, grabbing, dragging or pedal pulsation concerns; determine necessary action.	P	
2. Remove, clean (using proper safety procedures), inspect, and measure brake drums; service or replace as needed.	P	
6. Pre-adjust brake shoes and parking brake before installing brake drums or drum/hub assemblies and wheel bearings.	P	
7. Install wheel, torque lug nuts, and make final checks and adjustments.	P	
C. Disc Brake Diagnosis and Repair		
1. Diagnose poor stopping, noise, puling, grabbing, dragging or pedal pulsation concerns; determine necessary action.	P	
2. Remove caliper assembly from mountings; clean and inspect for leaks and damage to caliper housing; determine necessary action.	P	
3. Clean and inspect caliper mounting and slides for wear and damage; determine necessary action.	P	
4. Remove, clean, and inspect pads and retaining hardware; determine necessary action.	P	
5. Disassemble and clean caliper assembly; inspect parts for wear, rust, scoring, and damage; replace seal, boot, and damaged or worn parts.	P	
6. Reassemble, lubricate, and reinstall caliper, pads, and related hardware; seat pads, and inspect for leaks.	P	
7. Clean, inspect, and measure rotor with a dial indicator and a micrometer; follow manufacturer's recommendations in determining need to machine or replace.	P	
8. Refinish rotor according to manufacturer's recommendations.	P	
10. Install wheel, torque lug nuts, and make final checks and adjustments.	P	
D. Power Assist Units Diagnosis and Repair (NONE)		
E. Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, Etc.) Diagnosis and Repair		
1. Diagnose wheel bearing noises, wheel shimmy, and vibration concerns; determine necessary action.	P	
2. Remove, clean, inspect, repack, and install wheel bearings and replace seals; install hub and adjust wheel bearings.	P	
4. Check parking brake operation; adjust as needed.	P	

Task	12	AD
6. Check operation of brake stop light system; adjust and service as needed.	P	
7. Replace wheel bearing and race.	P	
F. Anti-lock Brake System		
3. Diagnose anti-lock brake system (ABS) electronic control(s) and components using self-diagnosis and/or recommended test equipment; determine necessary action.	P	

AREA 2: BRAKES--Priority Two (14)

Task	12	AD
. Hydraulic System Diagnosis and Repair		
1. Measure and adjust pedal height.	P	
2. Check master cylinder for internal and external leaks and proper operation; determine necessary action.	P	
5. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging or wear; tighten loose fittings and supports; determine necessary action.	P	
6. Fabricate and install brake lines (double flare and ISO types); replace hoses, fittings, and supports as needed.	P	
B. Drum Brake Diagnosis and Repair		
3. Mount brake drum on lathe; machine braking surface.	P	
4. Remove, clean, and inspect brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble.	P	
5. Remove, Inspect, and install wheel cylinders.	P	
C. Disc Brake Diagnosis and Repair		
11. Remove and replace rotor.	P	
D. Power Assist Units Diagnosis and Repair		
1. Test pedal free travel with and without engine running; check power assist operation.	P	PR
2. Check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster.	P	
3. Inspect the vacuum-type power booster unit for vacuum leaks; inspect the check valve for proper operation; determine necessary action.	P	
E. Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, Etc.) Diagnosis and Repair		
3. Check parking brake cables and components for wear, rusting, binding, and corrosion; clean, lubricate, and replace as needed.	P	
F. Anti-lock Brake System		
1. Inspect and test anti-lock brake system (ABS) components; determine necessary action.	P	R
2. Diagnose poor stopping, wheel lock-up, abnormal pedal feel or pulsation, and noise concerns caused by the anti-lock brake system (ABS); determine necessary action.	P	R
4. Depressurize high-pressure components of the anti-lock brake system (ABS).	P	R
5. Bleed the anti-lock brake system's (ABS) front and rear hydraulic circuits.	P	R
7. Service, test, and adjust anti-lock brake system (ABS) speed sensors.	IR	PR

AREA 2: BRAKES–Priority Three (5)

Task	12	AD
A. Hydraulic System Diagnosis and Repair		
8. Inspect, test, and replace metering (hold-off), proportioning (balance), pressure differential, and combination valves.	P	R
9. Inspect, test, replace, and adjust height (load) sensing proportioning valve.	IR	PR
10. Inspect, test, and replace components of brake warning light system.	P	R
12. Flush hydraulic system.	P	
B. Drum Brake Diagnosis and Repair (NONE)		
C. Disc Brake Diagnosis and Repair		
9. Adjust calipers with integrated parking brake system.	P	PR
D. Power Assist Units Diagnosis and Repair		
4. Inspect and test hydro-boost system and accumulator for leaks and proper operation; determine necessary action.	P	R
E. Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, Etc.) Diagnosis and Repair		
5. Check operation of parking brake indicator light system.	P	
F. Anti-lock Brake System		
6. Remove and install anti-lock brake system (ABS) electrical/electronic and hydraulic components.	I	P
8. Diagnose anti-lock brake system (ABS) braking concerns caused by vehicle modifications (tire size, curb height, final drive ratio, etc.).	I	P

AREA 3: ELECTRICAL/ELECTRONIC SYSTEMS—Priority One (20)

Task	12	AD
A. General Electrical System Diagnosis		
1. Use wiring diagrams during diagnosis of electrical circuit problems.	P	
3. Check voltage and voltage drop in electrical/electronic circuits using a digital multimeter (DMM); determine necessary action.	P	
4. Check current flow in electrical/electronic circuits and components using an ammeter; determine necessary action.	P	
5. Check continuity and resistances in electrical/electronic circuits and components with an ohmmeter; determine necessary action.	P	
7. Locate shorts, grounds, opens, and resistance problems in electrical/electronic circuits; determine necessary action.	P	
8. Measure and diagnose the cause(s) of abnormal key-off battery drain; determine necessary action.	P	
9. Inspect and test fusible links, circuit breakers, and fuses; determine necessary action.	P	
10. Inspect and test switches, connectors, relays, and wires of electrical/electronic circuits; perform necessary action.	P	
11. Repair wiring harnesses and connectors.	P	
12. Perform solder repair of electrical wiring.	P	
B. Battery Diagnosis and Service		
1. Perform battery state-of-charge test; determine needed service.	P	
2 Perform battery capacity test; determine needed service.	P	
6. Inspect and clean battery cables, connectors, clamps, and hold-downs; repair or replace as needed.	P	
7. Start a vehicle using jumper cables and a battery or auxiliary power supply according to manufacturers recommended specifications.	P	
C. Starting System Diagnosis and Repair		
1. Perform starter current draw tests; determine necessary action.	P	
2. Perform starter circuit voltage drop tests; determine necessary action.	P	
D. Charging System Diagnosis and Repair		
1. Perform charging system output test; determine necessary action.	P	
2. Diagnose charging system for the cause of undercharge, no-charge, and overcharge conditions.	P	
3. Inspect and adjust generator (alternator) drive belts; replace as needed.	P	
7. Perform charging circuit voltage drop tests; determine necessary action.	P	
E. Lighting Systems Diagnosis and Repair (NONE)		

Task	12	AD
. Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair		
3. Diagnose the cause of incorrect operation of warning devices and other driver information systems; determine necessary action.	P	
G. Horn and Wiper/Washer Diagnosis and Repair (NONE)		
H. Accessories Diagnosis and Repair (NONE)		

AREA 3: ELECTRICAL/ELECTRONIC SYSTEMS—Priority Two (13)

Task	12	AD
A. General Electrical System Diagnosis		
2. Check electrical circuits with a test light; determine necessary action.	P	R
6. Check electrical circuits using jumper wires; determine necessary action.	P	R
B. Battery Diagnosis and Service		
3. Maintain or restore electronic memory functions.	P	R
4. Inspect, clean, fill, and replace battery.	P	PR
5. Perform slow/fast battery charge.	P	PR
C. Starting System Diagnosis and Repair		
3. Inspect and test starter relays and solenoids; replace as needed.	IR	PR
4. Remove and install starter.	P	
6. Inspect and test switches, connectors, and wires of starter control circuits; perform necessary action.	P	R
D. Charging System Diagnosis and Repair		
4. Inspect and test voltage regulator/regulating circuit; perform necessary action.	P	R
5. Remove inspect, and install generator (alternator).	P	PR
E. Lighting Systems Diagnosis and Repair		
1. Diagnose the cause of brighter than normal, intermittent, dim, or no light operation; determine necessary action.	P	PR
2. Inspect, replace, and aim headlights and bulbs.	P	
3. Inspect and diagnose incorrect turn signal or hazard light operation; perform necessary action.	P	PR
F. Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair		
1. Inspect and test gauges and gauge sending units for cause of intermittent, high, low, or no gauge readings; determine necessary action.	I	P
G. Horn and Wiper/Washer Diagnosis and Repair (NONE)		
H. Accessories Diagnosis and Repair		
1. Diagnose incorrect operation of motor-driven accessory circuits; determine necessary action.	I	P
5. Diagnose supplemental restraint system (SRS) concerns; determine necessary action. (Note: Follow manufacturer's safety procedures to prevent accidental deployment.)	I	PR

AREA 3: ELECTRICAL/ELECTRONIC SYSTEMS—Priority Three (6)

Task	12	AD
A. General Electrical System Diagnosis (NONE)		
B. Battery Diagnosis and Service (NONE)		
C. Starting System Diagnosis and Repair		
5. Perform starter bench tests; determine necessary action.	IR	PR
7. Disassemble, clean, inspect, and test starter components; replace as needed.	IR	PR
D. Charging System Diagnosis and Repair		
6. Disassemble generator (alternator), clean, inspect, and test components; determine necessary action.	IR	PR
E. Lighting Systems Diagnosis and Repair (NONE)		
F. Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair		
2. Inspect and test connectors, wires, and printed circuit boards of gauge circuits; determine necessary action.	I	P
4. Inspect and test sensors, connectors, and wires of electronic instrument circuits; determine necessary action.	I	P
G. Horn and Wiper/Washer Diagnosis and Repair		
1. Diagnose incorrect horn operation; perform necessary action.	P	R
2. Diagnose incorrect wiper operation; diagnose wiper speed control and park problems; perform necessary action.	IR	PR
3. Diagnose incorrect windshield washer operation; perform necessary action.	P	PR
H. Accessories Diagnosis and Repair		
2. Diagnose incorrect heated glass operation; determine necessary action.	P	PR
3. Diagnose incorrect electric lock operation; determine necessary action.	IR	PR
4. Diagnose incorrect operation of cruise control systems; repair as needed.	IR	PR
6. Diagnose radio static and weak, intermittent, or no radio reception; determine necessary action.	I	P

AREA 4: ENGINE PERFORMANCE—Priority One (26)

Task	12	AD
A. General Engine Diagnosis		
1. Interpret and verify concern; determine necessary action.	I	P
5. Perform engine absolute (vacuum/boost) manifold pressure tests; determine necessary action.	P	R
6. Perform cylinder power balance test; determine necessary action.	P	
7. Perform cylinder compression test; determine necessary action.	P	
8. Perform cylinder leakage test; determine necessary action.	P	
9. Diagnose engine mechanical, electrical, electronic, fuel, and ignition concerns with an oscilloscope and engine diagnostic equipment; determine necessary action.	I	P
10. Prepare 4 or 5 gas analyzer; inspect and prepare vehicle for test, and obtain exhaust readings; interpret readings, and determine necessary action.	I	P
B. Computerized Engine Controls Diagnosis and Repair		
1. Retrieve and record stored OBD I diagnostic trouble codes; clear codes.	P	R
3. Diagnose the causes of emissions or driveability concerns resulting from failure of computerized engine controls with stored diagnostic trouble codes.	I	P
4. Diagnose emissions or driveability concerns resulting from failure of computerized engine controls with no stored diagnostic trouble codes; determine necessary action.	I	P
6. Obtain and interpret digital multimeter (DMM) readings.	I	R
8. Locate and interpret vehicle and major component identification numbers (VIN, vehicle certification labels, and calibration decals).	P	
9. Inspect and test power and ground circuits and connections; service or replace as needed.	P	R

Task	12	AD
C. Ignition System Diagnosis and Repair		
1. Diagnose no-starting, driveability, and emissions concerns on vehicles with electronic ignition (EI/DIS) (distributorless) systems; determine necessary action.	*I*	P
2. Diagnose no-starting, driveability, and emissions concerns on vehicles with distributor ignition (DI) systems; determine necessary action.	I	P
7. Check and adjust (where applicable) ignition system timing and timing advance/retard.	P	
D. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair		
2. Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems on vehicles with injection-type fuel systems; determine necessary action.	*I*	P
6. Replace fuel filters.	P	
7. Inspect and test fuel pressure regulation system and components of injection-type fuel systems; perform necessary action.	I	P
16. Perform exhaust system back-pressure test; determine necessary action.	I	
E. Emissions Control Systems Diagnosis and Repair		
1. Positive Crankcase Ventilation		
1. Diagnose oil leaks, emissions, and driveability problems resulting from failure of the positive crankcase ventilation (PCV) system; determine necessary action.	*P*	R
2. Exhaust Gas Recirculation		
1. Diagnose emissions and driveability problems caused by failure of the exhaust gas recirculation (EGR) system; determine necessary action.	*I*	P
3. Exhaust Gas Treatment (NONE)		
4. Intake Air Temperature Controls (NONE)		
5. Early Fuel Evaporation (Intake Manifold Temperature) Controls (NONE)		
6. Evaporative Emissions Controls (NONE)		
F. Engine Related Service		
1. Adjust valves on engines with mechanical or hydraulic lifters.	*I*	
2. Verify correct camshaft timing; determine necessary action.	P	
3. Verify engine operating temperature; determine necessary action.	P	
4. Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank, and hoses; perform necessary action.	P	
5. Inspect and test thermostat, by-pass, and housing; perform necessary action.	P	

AREA 4: ENGINE PERFORMANCE—Priority Two (25)

Task	**12**	**AD**
A. General Engine Diagnosis		
2. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.	P	R
3. Diagnose unusual engine noise or vibration concerns; determine necessary action.	I	P
4. Diagnose unusual exhaust color, odor, and sound; determine necessary action.	I	P
B. Computerized Engine Controls Diagnosis and Repair		
5. Inspect and test computerized engine control system sensors, powertrain control module (PCM), actuators, and circuits; perform necessary action.	I	P
10. Practice recommended precautions when handling static sensitive devices.	P	R
11. Diagnose driveability and emissions problems resulting from failures of interrelated systems (cruise control, security alarms, suspension controls, traction controls, A/C, automatic transmissions, non-OEM-installed accessories, and similar systems); determine necessary action.	I	P
C. Ignition System Diagnosis and Repair		
3. Inspect and test ignition primary circuit wiring and components; perform necessary action.	P	R
5. Inspect and test ignition system secondary circuit wiring and components; perform necessary action.	I	P
6. Inspect and test ignition coil(s); perform necessary action.	P	R
8. Inspect and test ignition system pick-up sensor or triggering devices; perform necessary action.	IR	PR
9. Inspect and test ignition control module; perform necessary action.	IR	PR
D. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair		
3. Inspect fuel tank and fuel cap, fuel lines, fittings, and hoses, perform necessary action.	P	PR
4. Check fuel for contaminants and quality; determine necessary action.	I	P

Task	12	AD
5. Inspect and test mechanical and electrical fuel pumps and pump control systems; perform necessary action.	IR	PR
9. Remove, service, and install throttle body; adjust related linkages.	P	R
10. Inspect, test, and clean fuel injectors.	IR	PR
11. Inspect throttle body mounting plates, air induction and filtration system, intake manifold, and gaskets; perform necessary action.	P	R
12. Check idle speed and fuel mixture.	P	PR
14. Remove, inspect, and test vacuum and electrical circuits, components and connections of fuel system; perform necessary action.	I	P
15. Inspect exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shield(s); perform necessary action.	P	R
E. Emissions Control Systems Diagnosis and Repair		
1. Positive Crankcase Ventilation		
2. Inspect and test positive crankcase ventilation (PCV) filter/breather cap, valve, tubes, orifices, and hoses; perform necessary action.	P	R
2. Exhaust Gas Recirculation		
2. Inspect and test valve, valve manifold, and exhaust passages of exhaust gas recirculation (EGR) systems; perform necessary action.	IR	PR
3. Inspect and test vacuum/pressure controls, filters, and hoses of exhaust gas recirculation (EGR) systems; perform necessary action.	I	P
4. Inspect and test electrical/electronic sensors, controls, and wiring of exhaust gas recirculation (EGR) systems; perform necessary action.	I	P
3. Exhaust Gas Treatment		
1. Diagnose emissions and driveability problems resulting from failure of the secondary air injection and catalytic converter systems; determine necessary action.	I	PR
2. Inspect and test mechanical components of secondary air injection systems; perform necessary action.	I	PR
3. Inspect and test electrical/electronically-operated components and circuits of air injection systems; perform necessary action.	I	P
4. Inspect and test components of catalytic converter systems; perform necessary action.	IR	PR
4. Intake Air Temperature Controls (NONE)		
5. Early Fuel Evaporation (Intake Manifold Temperature) Controls (NONE)		
6. Evaporative Emissions Controls		
1. Diagnose emissions and driveability problems resulting from failure of evaporative emissions control system; determine necessary action.	I	P
2. Inspect and test components and hoses of evaporative emissions control system; perform necessary action.	IR	PR

Task	**12**	**AD**
F. Engine Related Service		
6. Inspect and test mechanical/electrical fans, fan clutch, fan shroud/ducting, air dams, and fan control devices; perform necessary action.	IR	PR

AREA 4: ENGINE PERFORMANCE—Priority Three (6)

Task	12	AD
A. General Engine Diagnosis (NONE)		
B. Computerized Engine Controls Diagnosis and Repair		
2. Retrieve and record stored OBD II diagnostic trouble codes; clear codes.	P	R
7. Access and use electronic service information (ESI).	P	R
C. Ignition System Diagnosis and Repair		
4. Inspect and test distributor; perform necessary action.	P	PR
D. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair		
1. Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems on vehicles with carburetor-type fuel systems; determine necessary action.	I	P
8. Inspect and test cold enrichment system and components; perform necessary action.	I	P
13. Adjust (**carborated**) idle speed and fuel mixture.	I	P
17. Test the operation of turbocharger/supercharger systems; determine necessary action.	I	P
E. Emissions Control Systems Diagnosis and Repair		
1. Positive Crankcase Ventilation (NONE)		
2. Exhaust Gas Recirculation (NONE)		
3. Exhaust Gas Treatment (NONE)		
4. Intake Air Temperature Controls		
1. Diagnose emissions and driveability problems resulting from failure of the intake air temperature control system; determine necessary action.	I	PR
2. Inspect and test components of intake air temperature control system; perform necessary action.	I	PR
5. Early Fuel Evaporation (Intake Manifold Temperature) Controls		
1. Diagnose emissions and driveability problems resulting from failure of early fuel evaporation control system; determine necessary action.	I	PR
2. Inspect and test components of early fuel evaporation control system; perform necessary action.	I	PR
6. Evaporative Emissions Controls (NONE)		
F. Engine Related Service (NONE)		

Certification in the following four areas is not required to meet minimum ASE requirements (1999 Standards) or the new Ohio Tech Prep Standards.

1. Engine Repair
2. Automatic Transmission and Transaxle
3. Manual Drive Train and Axles
4. Heating and Air Conditioning

In Ohio, participation in any of the above certification programs is strictly optional. However, if a school pursues certification in any of these areas, then the competencies listed in the applicable section of the following technical competency profiles must be taught to the depth and at the level specified.

In addition, the Automotive Technical Competency Releveling Advisory Panel requires that the asterisk (*) competencies in the following TCPs be covered in any Automotive Tech Prep program in Ohio (even if certification is not pursued in these areas).

AREA 5: ENGINE REPAIR–Priority One (15)

Task	12	AD
C. General Engine Diagnosis; Removal and Reinstallation (R & R)		
1. Verify and interpret engine concern; determine necessary action.	IR	PR
5. Perform engine vacuum tests; determine necessary action.	P	
6. Perform cylinder power balance tests; determine necessary action	P	
7. Perform cylinder compression tests; determine necessary action.	P	
8. Perform cylinder leakage tests; determine necessary action.	P	
B. Cylinder Head and Valve Train Diagnosis and Repair		
13. Adjust valves (mechanical or hydraulic lifters).	P	
* 15. Inspect and replace timing belt(s), overhead camdrive sprockets, and tensioners; check belt tension; adjust as necessary.	P	
18. Verify camshaft(s) timing according to manufacturer's specifications and procedure.	P	
C. Engine Block Assembly Diagnosis and Repair		
* 3. Inspect internal and external threads; restore as needed (includes installing thread inserts).	P	
6. Deglaze and clean cylinder walls.	P	
16. Prime engine lubrication system.	IR	PR
D. Lubrication and Cooling Systems Diagnosis and Repair		
* 1. Perform oil pressure tests; determine necessary action.	P	
3. Perform cooling system, cap, and recovery system tests (pressure, combustion leakage, and temperature); determine necessary action.	P	
* 4. Inspect, replace, and adjust drive belts, tensioners, and pulleys.	P	
* 7. Test coolant; drain and recover coolant; flush and refill cooling system with recommended coolant; bleed air as required.	P	
* 13. Perform oil and filter change.	P	

AREA 5: ENGINE REPAIR– Priority Two (18)

Task	12	AD
A. General Engine Diagnosis; Removal and Reinstallation (R & R)		
* 2. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.	P	R
B. Cylinder Head and Valve Train Diagnosis and Repair		
1. Remove cylinder head(s); visually inspect cylinder head(s) for cracks; check gasket surface areas for warpage and leakage; check passage condition.	P	R
2. Install cylinder heads and gaskets; tighten according to manufacturer's specifications and procedures.	P	R
4. Inspect value spring retainers, locks, and valve grooves.	P	PR
7. Resurface values; perform necessary action.	IR	PR
8. Resurface valve seats; perform necessary action.	IR	PR
10. Check valve spring assembled height and valve stem height; service valve and spring assemblies as needed.	*IR*	PR
11. Inspect pushrods, rocker arms, rocker arm pivots and shafts for wear, bending, cracks, looseness, and blocked oil passages (orifices); perform necessary action.	IR	PR
12. Inspect hydraulic or mechanical lifters; replace as needed.	IR	PR
14. Inspect camshaft drives (including gear wear and backlash, sprocket and chain wear); replace as necessary.	IR	PR
C. Engine Block Assembly Diagnosis and Repair		
* 1. Inspect and replace pans, covers, gaskets, and seals.	P	PR
2. Inspect engine block for visible cracks, passage condition, core and gallery plug condition, and surface warpage; determine necessary action.	P	PR
5. Inspect and measure cylinder walls for damage and wear; determine necessary action.	IR	PR
9. Inspect and measure main and connecting rod bearings for damage, clearance, and end play; determine necessary action (includes the proper selection of bearings).	IR	PR
11. Inspect, measure, and service pistons and pins; determine necessary action.	IR	PR
12. Inspect, measure, and install piston rings.	IR	PR
* 14. Reassemble engine components using correct gaskets and sealants.	P	R
D. Lubrication and Cooling Systems Diagnosis and Repair		
5. Inspect and replace engine cooling and heater system hoses.	P	PR
6. Inspect, test, and replace thermostat and housing.	P	PR
* 8. Inspect, test, remove, and replace water pump.	IR	PR
* 9. Remove and replace radiator.	IR	PR
* 10. Inspect, and test fan(s) (electrical or mechanical), fan clutch, fan shroud, and air dams.	IR	PR
* 12. Inspect, test, and replace oil temperature and pressure switches and sensors.	IR	PR

AREA 5: ENGINE REPAIR--Priority Three (10)

Task	12	AD
A. General Engine Diagnosis; Removal and Reinstallation (R & R)		
3. Diagnose engine noises and vibrations; determine necessary action.	IR	PR
4. Diagnose the cause of excessive oil consumption, unusual engine exhaust color, odor, and sound; determine necessary action.	IR	PR
9. Remove engine (front-wheel drive); prepare for disassembly.	IR	PR
10. Reinstall engine (front-wheel drive).	IR	PR
11. Remove engine (rear-wheel drive); prepare for disassembly.	IR	PR
12. Reinstall engine (rear-wheel drive).	IR	PR
B. Cylinder Head and Valve Train Diagnosis and Repair		
3. Inspect and test valve springs for squareness, pressure, and free height comparison; replace as needed.	I	P
5. Replace valve stem seals.	IR	PR
6. Inspect valve guides for wear; check valve guide height and stem-to-guide clearance.	IR	PR
9. Check valve face-to-seat contact and valve seat concentricity (runout); service seats and valves as needed.	IR	PR
16. Inspect camshaft for runout, journal wear and lobe wear.	IR	PR
17. Inspect and measure camshaft bearing for wear, damage, out-of-round, and alignment; determine necessary action.	IR	PR
C. Engine Block Assembly Diagnosis and Repair		
4. Remove cylinder wall ridges.	P	R
7. Inspect and measure crankshaft bearings for wear, damage, out-of-round, and alignment; determine necessary action.	IR	PR
8. Inspect crankshaft for surface cracks and journal damage; check oil passage condition; measure journal wear; determine necessary action.	IR	PR
10. Identify piston and bearing wear patterns that indicate connecting rod alignment and main bearing bore problems; inspect rod alignment and bearing bore condition.	IR	PR
13. Inspect, repair or replace crankshaft vibration damper (harmonic balancer).	P	PR
15. Inspect auxiliary (balance, intermediate, idler, counterbalance or silencer) shaft(s); inspect shaft(s) and support bearing for damage and wear; determine necessary action; reinstall and time.	I	P
D. Lubrication and Cooling Systems Diagnosis and Repair		
2. Inspect oil pump gears or rotors, housing, pressure relief devices, and pump drive; perform necessary action.	IR	PR
11. Inspect auxiliary oil coolers; replace as needed.	P	PR

AREA 6: AUTOMATIC TRANSMISSION AND TRANSAXLE—Priority One

Task	12	AD
A. General Transmission and Transaxle Diagnosis		
1. Identify and interpret transmission concern; assure proper engine operation; determine necessary action.	I	P
* 2. Diagnose unusual fluid usage, level, and condition concerns; determine necessary action.	I	P
3. Perform pressure tests; determine necessary action.		P
5. Diagnose electronic, mechanical, hydraulic, vacuum control system concerns; determine necessary action.	I	P
B. Transmission and Transaxle Maintenance and Adjustment		
* 1. Inspect, adjust or replace throttle (TV) linkages or cables, check gear select indicator (as applicable).	I	P
* 2. Service transmission; perform visual inspection; replace fluids and filters.	P	R
C. In-Vehicle Transmission and Transaxle Repair		
* 5. Inspect, leak test, flush, and replace cooler, lines, and fittings.	P	R
7. Inspect and test, adjust, repair or replace transmission related electrical and electronic components (includes computers, solenoids, sensors, relays, switches, and harnesses).	I	P
D. Off-Vehicle Transmission and Transaxle Repair		
9. Removal, Disassembly, and Reinstallation		
3. Disassemble, clean, and inspect transmission/transaxle.		P
7. Assemble transmission/transaxle.		P
10. Oil Pump and Converter		
4. Check torque converter and transmission cooling system for contamination.		P
11. Gear Train, Shafts, Bushings and Case		
1. Measure endplay or preload; determine necessary action.		P
12. Friction and Reaction Units		
2. Measure clutch pack clearance; adjust as needed.		P
3. Air test operation of clutch and servo assemblies.		P

AREA 6: AUTOMATIC TRANSMISSION AND TRANSAXLE—Priority Two

Task	12	AD
A. General Transmission and Transaxle Diagnosis		
4. Perform lock-up converter system tests; determine necessary action.		P
B. Transmission and Transaxle Maintenance and Adjustment (NONE)		
C. In-Vehicle Transmission and Transaxle Repair		
* 3. Inspect and replace external seals and gaskets.	P	R
D. Off-Vehicle Transmission and Transaxle Repair		
1. Removal, Disassembly, and Reinstallation		
1. Remove and reinstall transmission and torque converter (rear-wheel drive).	IR	P
2. Remove and reinstall transaxle and torque converter assembly.	IR	P
4. Inspect, measure, clean, and replace valve body (includes surfaces and bores, springs, valves, sleeves, retainers, brackets, check-balls, screens, spacers, and gaskets), and torque valve body bolts.		P
2. Oil Pump and Converter		
1. Inspect converter flex plate, attaching parts, pilot, pump drive, and seal areas.	IR	P
2. Measure torque converter endplay and check for interference; check stator clutch.		P
3. Gear Train, Shafts, Bushings and Case		
2. Inspect, measure, and replace thrust washers and bearings.		P
3. Inspect oil delivery seal rings, ring grooves, and sealing surface areas.		P
4. Inspect bushings; replace as needed.		P
5. Inspect and measure planetary gear assembly (includes sun, ring gear, thrust washers, planetary gears, and carrier assembly); replace as needed.		P
6. Inspect case bores, passages, bushings, vents, and mating surfaces; determine necessary action.		P
7. Inspect transaxle drive, link chains, sprockets, gears, bearings, and bushings; perform necessary action.		P
8. Inspect, measure, repair, adjust or replace transaxle final drive components.		P
4. Friction and Reaction Units		
1. Inspect clutch drum, piston, check-balls, springs, retainers, seals, and friction and pressure plates; replace as needed.		P
4. Inspect roller and sprag clutch, races, rollers, sprags, springs, cages, and retainers; replace as needed.		P

AREA 6: AUTOMATIC TRANSMISSION AND TRANSAXLE—Priority Three

Task	12	AD
A. General Transmission and Transaxle Diagnosis		
6. Diagnose noise and vibration concerns; determine necessary action.		P
B. Transmission and Transaxle Maintenance and Adjustment (NONE)		
C. In-Vehicle Transmission and Transaxle Repair		
1. Inspect, adjust or replace (as applicable) vacuum modulator; inspect and repair or replace lines and hoses.	IR	P
2. Inspect, repair, and replace governor assembly.	I	P
4. Inspect extension housing, bushings and seals; perform necessary action.	IR	P
6. Inspect and replace speedometer drive gear, driven gear, vehicle speed sensor (VSS), and retainers.	IR	P
* 8. Inspect, replace, and align powertrain mounts.	P	PR
D. Off-Vehicle Transmission and Transaxle Repair		
1. Removal, Disassembly, and Reinstallation		
5. Inspect servo bore, piston, seals, pin, spring, and retainers; determine necessary action.		P
6. Inspect accumulator bore, piston, seals, spring, and retainer; determine necessary action.		P
2. Oil Pump and Converter		
3. Inspect, measure, and replace oil pump assembly and components.		P
3. Gear Train, Shafts, Bushings and Case		
9. Inspect and reinstall parking pawl, shaft, spring, and retainer; determine necessary action.		P
4. Friction and Reaction Units		
5. Inspect bands and drums; adjust or replace as needed.		P

AREA 7: MANUAL DRIVE TRAIN AND AXLES—Priority One

Task	12	AD
A. Clutch Diagnosis and Repair		
1. Diagnose clutch noise, binding, slippage, pulsation, and chatter; determine necessary action.	I	P
2. Inspect clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs; perform necessary action.	I	P
3. Inspect hydraulic clutch slave and master cylinders, lines, and hoses; perform necessary action.	I	P
4. Inspect release (throw-out) bearing, lever, and pivot; perform necessary action.	I	P
5. Inspect and replace clutch pressure plate assembly and clutch disc.	IR	P
6. Inspect, remove or replace crankshaft pilot bearing or bushing (as applicable).	IR	P
7. Inspect flywheel and ring gear for wear and cracks, measure runout; determine necessary action.	IR	P
B. Transmission/Transaxle Diagnosis and Repair		
10. Measure endplay or preload (shim or spacer selection procedure) on transmission/transaxle shafts; perform necessary action.		P
16. Inspect, test, and replace transmission/transaxle sensors and switches.	I	P
C. Drive Shaft and Half Shaft, Universal and Constant-Velocity (CV) Joint Diagnosis and Repair		
* 4. Inspect, service, and replace shafts, yokes, boots, and CV joints.	P	PR
D. Drive Axle Diagnosis and Repair		
7. Ring and Pinion Gears and Differential Case Assembly		
7. Measure and adjust drive pinion bearing preload.	I	P
9. Check ring and pinion tooth contact patterns; perform necessary action.	I	P
8. Limited Slip Differential (NONE)		
9. Drive Axle Shaft		
* 3. Remove and replace drive axle shafts.	P	PR
E. Four-wheel Drive/All-wheel Drive Component Diagnosis and Repair (NONE)		

AREA 7: MANUAL DRIVE TRAIN AND AXLES—Priority Two

Task	12	AD
A. Clutch Diagnosis and Repair (NONE)		
B. Transmission/Transaxle Diagnosis and Repair		
1. Remove and reinstall transmission/transaxle.	**IR**	**PR**
2. Disassemble, clean, and reassemble transmission/transaxle components.	I	PR
7. Inspect and replace gaskets, seals, and sealants; inspect sealing surfaces.	IR	PR
9. Inspect, adjust, and reinstall shift cover, forks, levers, grommets, shafts, sleeves, detent mechanism, interlocks, and springs.	I	PR
11. Inspect and reinstall synchronizer hub, sleeve, keys (inserts), springs, and blocking rings.	I	PR
12. Inspect and reinstall speedometer drive gear, driven gear, vehicle speed sensor (VSS), and retainers.	IR	PR
14. Remove, inspect, measure, adjust, and reinstall transaxle final drive pinion gears (spiders), shaft, side gears, side bearings, thrust washers, and case assembly.	I	PR
C. Drive Shaft and Half Shaft, Universal and Constant-Velocity (CV) Joint Diagnosis and Repair		
1. Diagnose constant-velocity (CV) joint noise and vibration concerns; determine necessary action.	IR	PR
2. Diagnose universal joint noise and vibration concerns; perform necessary action.	IR	PR
3. Replace front wheel drive (FWD) front wheel bearing.	I	PR
D. Drive Axle Diagnosis and Repair		
1. Ring and Pinion Gears and Differential Case Assembly		
1. Diagnose noise and vibration concerns; determine necessary action.	I	PR
* 2. Diagnose fluid leakage concerns; determine necessary action.	P	R
3. Inspect and replace companion flange and pinion seal; measure companion flange runout.	I	PR
4. Inspect ring gear and measure runout; determine necessary action.	I	PR
5. Remove, inspect, and reinstall drive pinion and ring gear, spacers, sleeves, and bearings.	I	PR
6. Measure and adjust drive pinion depth.	I	PR
8. Measure and adjust side bearing preload and ring and pinion gear total backlash and backlash variation on a differential carrier assembly (threaded cup or shim types).	I	PR
10. Disassemble, inspect, measure, and adjust or replace differential pinion gears (spiders), shaft side gears, side bearings, thrust washers, and case.	I	PR
11. Reassemble and reinstall differential case assembly; measure runout; determine necessary action.	I	PR

Task	**12**	**AD**
2. Limited Slip Differential		
* 2. Inspect and flush differential housing; refill with correct lubricant.	P	PR
3. Drive Axle Shaft		
1. Diagnose drive axle shafts, bearings, and seals for noise, vibration, and fluid leakage concerns; determine necessary action.	I	PR
4. Inspect and replace drive axle shaft seals, bearings, and retainers.	I	PR
5. Measure drive axle flange runout and shaft endplay; determine necessary action.	I	PR
E. Four-wheel Drive/All-wheel Drive Component Diagnosis and Repair (NONE)		

AREA 7: MANUAL DRIVE TRAIN AND AXLES—Priority Three

Task	12	AD
A. Clutch Diagnosis and Repair		
8. Inspect engine block, clutch (bell) housing, and transmission/transaxle case mating surfaces; determine necessary action.	IR	PR
9. Measure flywheel-to-block runout and crankshaft endplay; determine necessary action.	IR	PR
B. Transmission/Transaxle Diagnosis and Repair		
3. Inspect transmission/transaxle case, extension housing, case mating surfaces, bores, bushings, and vents; perform necessary action.		P
4. Diagnose noise, hard shifting, jumping out of gear, and fluid leakage concerns; determine necessary action.	I	PR
5. Inspect, adjust, and reinstall shift linkages, brackets, bushings, cables, pivots, and levers.	IR	PR
6. Inspect and reinstall powertrain mounts.	P	PR
8. Remove and replace transaxle final drive.	I	PR
13. Diagnose transaxle final drive assembly noise and vibration concerns; determine necessary action.		P
15. Inspect lubrication devices (oil pump or slingers); perform necessary action.		P
C. Drive Shaft and Half Shaft, Universal and Constant-Velocity (CV) Joint Diagnosis and Repair		
5. Inspect, service, and replace shaft center support bearings.	IR	P
6. Check shaft balance; measure shaft runout; measure and adjust driveline angles.	I	P
D. Drive Axle Diagnosis and Repair		
1. Ring and Pinion Gears and Differential Case Assembly (NONE)		
2. Limited Slip Differential		
1. Diagnose noise, slippage, and chatter concerns; determine necessary action.	I	PR
3. Inspect and reinstall clutch (cone or plate) components.		P
4. Measure rotating torque; determine necessary action.		P
3. Drive Axle Shaft		
* 2. Inspect and replace drive axle shaft wheel studs.	P	PR
E. Four-wheel Drive/All-wheel Drive Component Diagnosis and Repair		
1. Diagnose noise, vibration, and unusual steering concerns; determine necessary action.		P
2. Inspect, adjust, and repair shifting controls (mechanical, electrical, and vacuum), bushings, mounts, levers, and brackets.		P
3. Remove and reinstall transfer case.		P
4. Disassemble, service, and reassemble transfer case and components.		P
5. Inspect front-wheel bearings and locking hubs; perform necessary action.		P
* 6. Check drive assembly seals and vents; check lube level.	P	R
7. Diagnose test, adjust, and replace electrical/electronic components of four-wheel drive systems.		P

AREA 8: HEATING AND AIR CONDITIONING—Priority One (15)

Task	12	AD
A. A/C System Diagnosis and Repair		
* 2. Identify refrigerant type; conduct a performance test of the A/C system; determine necessary action.	I	P
* 3. Leak test A/C system; determine necessary action.	I	P
B. Refrigeration System Component Diagnosis and Repair		
1. Compressor and Clutch (NONE)		
4. Evaporator, Condenser, and Related Components		
* 3. Inspect A/C condenser for airflow restrictions; perform necessary action.	P	R
C. Heating, Ventilation, and Engine Cooling Systems Diagnosis and Repair		
2. Perform cooling system, cap, and recovery system tests (pressure, combustion leakage, and temperature); determine necessary action.	P	
* 3. Inspect engine cooling and heater system hoses and belts; perform necessary action.	P	
4. Inspect, test, and replace thermostat and housing.	P	
5. Determine coolant condition; drain and recover coolant.	P	
6. Flush system; refill system with recommended coolant; bleed system.	P	
7. Inspect and test fan, fan clutch (electrical and mechanical), fan shroud, and air dams; perform necessary action.	P	PR
8. Inspect and test electrical fan control system and circuits.	I	P
D. Operating Systems and Related Controls Diagnosis and Repair (NONE)		
E. Refrigerant Recovery, Recycling, and Handling		
* * 1. Verify correct operation and maintenance of refrigerant handling equipment.	P	
* 2. Identify (by label application or use of a refrigerant identifier) and recover A/C system refrigerant.	P	
3. Recycle refrigerant.	P	
* 4. Label and store refrigerant.	P	

Task	12	AD
* 5. Test recycled refrigerant for non-condensable gases.	P	
6. Evacuate and charge A/C system.	P	

AREA 8: HEATING AND AIR CONDITIONING—Priority Two (12)

Task	12	AD
A. A/C System Diagnosis and Repair		
1. Diagnose unusual operating noises in the A/C system; determine necessary action.	I	PR
4. Inspect the condition of discharged oil; determine necessary action.	I	P
5. Select oil type; measure, and add oil to the A/C system as needed.	P	PR
B. Refrigeration System Component Diagnosis and Repair		
1. Compressor and Clutch		
1. Diagnose A/C system conditions that cause the protection devices (pressure, thermal, and PCM) to interrupt system operation; determine necessary action.	I	P
* 2. Inspect A/C compressor drive belts; replace and adjust as needed.	P	R
3. Inspect, test, and replace A/C compressor clutch components or assembly.	P	*R*
4. Remove and replace A/C compressor and mountings.	P	R
2. Evaporator, Condenser, and Related Components		
2. Remove and inspect A/C system mufflers, hoses, lines, fittings, o-rings, seals, and service valves; perform necessary action.	P	R
4. Remove and install receiver/drier or accumulator/drier.	P	R
5. Remove and install expansion valve or orifice (expansion) tube.	P	R
C. Heating, Ventilation, and Engine Cooling Systems Diagnosis and Repair		
1. Diagnose temperature control problems in the heater/ventilation system; determine necessary action.	IR	PR
9. Inspect and test heater control valve(s); perform necessary action.	P	*R*
D. Operating Systems and Related Controls Diagnosis and Repair		
1. Diagnose failures in the electrical controls of heating, ventilation, and A/C (HVAC) systems; determine necessary action.	IR	PR
2. Inspect and test A/C-heater blower, motors, resistors, switches, relays, wiring, and protection devices; perform necessary action.	IR	PR
4. Diagnose failures in the vacuum and mechanical components and controls of the heating, ventilation, and A/C (HVAC) system; determine necessary action.	IR	PR
E. Refrigerant Recovery, Recycling, and Handling (NONE)		

AREA 8: HEATING AND AIR CONDITIONING—Priority Three (4)

Task	12	AD
A. A/C System Diagnosis and Repair (NONE)		
B. Refrigeration System Component Diagnosis and Repair		
1. Compressor and Clutch (NONE)		
2. Evaporator, Condenser, and Related Components		
1. Determine need for A/C system filter; perform necessary action.	P	PR
6. Inspect evaporator housing water drain; perform necessary action.	P	R
C. Heating, Ventilation, and Engine Cooling Systems Diagnosis and Repair (NONE)		
D. Operating Systems and Related Controls Diagnosis and Repair		
3. Test A/C compressor load cut-off systems; determine necessary action.	I	P
5. Inspect and test A/C-heater control panel assembly; determine necessary action.	IR	PR
6. Inspect and test A/C-heater control cables and linkages; perform necessary action.	IR	PR
7. Inspect and test A/C-heater ducts, doors, hoses, and outlets; perform necessary action.	IR	PR
8. Check operation of automatic and semi -automatic heating, ventilation, and air-conditioning (HVAC) control systems; determine necessary action.	I	IR
E. Refrigerant Recovery, Recycling, and Handling (NONE)		

Unit 1: Quality Assurance

BIL: Essential
AC:

EDU:	12	AD
	P	**R**

Competency 1.1: **Demonstrate knowledge of quality assurance**

Competency Builders:
Explain changes brought about by quality leaders in the world
Define quality terms
Define quality functions
Identify features of quality planning
Explain the relationship among organizational structures, policies, procedures, and quality assurance
Explain importance of internal and external customers
Describe successful efforts by industry to improve quality and/or reduce costs
Differentiate between prevention and detection

BIL: Essential
AC:

EDU:	12	AD
	I	**P**

Competency 1.2: **Demonstrate knowledge of quality cost implications**

Competency Builders:
Identify cost/quality objectives
Classify costs (i.e., direct and indirect, fixed and variable, methods and standards)
Classify quality costs (i.e., prevention, evaluation, pre-delivery failure, post-delivery failure)
Define product liability
Interpret quality cost reports
Explain consumerism and liability prevention

Define safety terms of product
Identify safety responsibility within organization
Differentiate between expressed and implied warranty
Differentiate between warranty and product liability
Explain how warranties are part of contract law
List questions that would need answering in liability claim

BIL: Essential
AC:

EDU:	12	AD
	I	**P**

Competency 1.3: **Demonstrate knowledge of providing a quality service**

Competency Builders:

Associate customer satisfaction with service characteristics (e.g., usefulness, price, operation, life, reliability, safety, cost of operation)
Identify steps in service design (e.g., brainstorming, thumbnail sketches, rendering)
Define reliability factors (e.g., cost, human, producibility)
Identify ways reliability is achieved (e.g., maintainability, good design, design simplification, design redundancy)
Explain the relationship of maintainability to reliability
Define failure
Explain the tole of testing and reliability
Define value performance
Define quality objectives
Identify cost components as they relate to quality objectives
Classify quality costs (i.e., preventive, evaluation, pre-delivery failures, post-delivery failures)

BIL: Essential
AC:

EDU:	12	AD
	P	**R**

Competency 1.4: **Explain importance of interdepartmental relationships to quality assurance**

Competency Builders:
Explain need for everyone's commitment in assuring quality
Explain phrase "Everyone is a customer/supplier"
Define quality improvement team models
Explain the importance of top management's support of quality
Explain project selection
Explain project implementation
Explain project evaluation
Explain continuing improvement

Unit 2: Technical Recording and Reporting

BIL: Essential
AC:

EDU:	12	AD
	P	**R**

Competency 2.1: **Demonstrate proficiency in technical recording**

Competency Builders:
Describe various documentation procedures
Interpret specifications or drawings
Observe process
Ask open-ended questions
Record process (e.g., flowchart, step-by-step)
Identify parameters
Record accurate, truthful data
Maintain test logs
Compile cumulative references notebook/record
Measure appropriate parameters
Draft preventative maintenance
Apply calibration procedures

BIL: Essential
AC:

EDU:	12	AD
	P	**R**

Competency 2.2: **Demonstrate proficiency in technical reporting**

Competency Builders:
Use data books and cross reference/technical manuals
Compose technical memoranda
Identify type of report or format needed
Use appropriate format

Compile relevant data
Design charts and graphs
Analyze data
Draw conclusions
Explain analytical methods used
Outline reports
Present reports

Unit 3: Workplace Safety

BIL: Essential
AC:

EDU:	12	AD
	P	**R**

Competency 3.1: Apply general safety precautions

Competency Builders:
Identify local, state, and federal regulatory agencies
Identify personal protective wear and equipment
Identify visual controls (e.g., monitors, read outs)
Identify auditory controls
Identify common sense housekeeping
Interpret hazardous materials notices on containers
Use personal protective wear and equipment
Apply personal safety rules and procedures
Apply workplace organization (e.g., housekeeping)
Apply applicable electrical, mechanical, steam, hydraulic, and pneumatic safety rules and procedures
Apply fire safety rules and procedures
Apply hazardous wastes rules and procedures
Apply first aid
Locate MSDS
Perform lockout and tagout
Recycle scrap metal, chips, shavings, coolants, colvents, trash, and waste materials
Apply common sense housekeeping
Use preventative maintenance checklists

BIL: Essential
AC:

EDU:	12	AD
	P	**PR**

Competency 3.2: **Demonstrate knowledge of safety and workplace hazards**

Competency Builders:

Describe corrective procedures for unsafe conditions
Identify types of potential level of workplace hazards (e.g., physical hazards, fire, chemicals, noise, ionizing radiation, ultraviolet, temperature extremes, ergonomics, biological hazards)
Identify safety materials/equipment (e.g., absorbant socks, oil dry)
Interpret Material Safety Data Sheets (MSDS)
Explain purpose(s) of NEC and NFPA
Identify purpose of emergency evacuation routes, master switch and lockout locations, and safety color coding systems
Identify roles of industrial hygienists, safety professionals, occupational physicians, and occupational nurses
Describe methods of evaluating potential hazards (e.g., visual analysis)
Describe methods of correcting potential hazards
Describe various types of toxicity (e.g., chronic, immediate)
Identify need for reporting accidents
Explain precautions required when using toxic of flammable materials
Define confined space and related requirements

BIL: Essential
AC:

EDU:	12	AD
	P	**PR**

Competency 3.3: **Explain purpose of industrial pollution control systems**

Competency Builders:
Describe types of air, water, solid waste, and noise pollution
Explain purpose of air pollution control systems
Explain purpose of water pollution control systems
Explain purpose of solid waste pollution control systems
Explain purpose of noise pollution control systems
Explain basic philosophy of "right to know" legislation
Explain purpose(s) of EPA
Identify "costs" of industrial pollution control (i.e., dollars vs. impact to environment)
Describe ethics of environmental issues

BIL: Essential
AC:

EDU:	12	AD
	P	**PR**

Competency 3.4: **Demonstrate knowledge of ergonomics**

Competency Builders:
Define ergonomics
Define risk factor
Define maximum permissible limit (MPL) and action limit (AL) for lifting
Define cumulative trauma disorder
Minimize extreme joint movement
Minimize use of excessive muscle force
Minimize repetitive tasks

Minimize mechanical stresses (e.g., sharp edges, heat, cold, hard surfaces, weights, vibration)
Minimize awkward body positions
Explain use of rest pauses
Explain need for mats and footrest for standing jobs
Explain need for appropriate working heights of chairs, stools, workbenches, and equipment
Explain need for adequate lighting

Unit 4: Management and Supervision

BIL: Essential
AC:

EDU:	12	AD
	P	**R**

Competency 4.1: **Maintain a safe working environment**

Competency Builders:

Demonstrate knowledge of the relationship between health, safety, and productivity
Identify health and safety standards established by government agencies
Access needed safety information using company and manufacturers' references (e.g., procedural manuals, documentation, standards, and flowcharts)
Establish preventive measure for dealing with the main causes of accidents in the facility
Establish preventive measures for dealing with the main causes of health problems in the facility
Establish preventive measures for dealing with violations of personnel security
Ensure compliance with government and/or company rules and regulations related to health and safety
Ensure maintenance of a clean work area
Perform safety audits and inspections
Solve safety problems using problem solving, decision-making, and critical thinking strategies

BIL: Essential
AC:

EDU:	12	AD
	P	**R**

Competency 4.2: **Guide progress in assigned areas of responsibility/accountability**

Competency Builders:
Set short- and long-term goals for assigned areas of responsibility/accountability
Demonstrate commitment to established goals and vision
Obtain support for goals
Provide support for goals
Monitor goal achievement
Adjust goals
Communicate goal achievement
Provide recognition for goal achievement

BIL: Recommended
AC:

EDU:	12	AD
	I	I

Competency 4.3: Perform staffing functions

Competency Builders:
Develop plans and procedures for identifying staffing needs
Identify staffing needs in accordance with plans
Develop job descriptions
Develop hiring and promotion policies and procedures in compliance with state and federal employment laws
Establish guidelines for selecting the most qualified person for a specific position
Comply with state and federal employment laws and company hiring policies and procedures
Identify resources for locating candidates
Recruit candidates
Identify most appropriate candidates for position in accordance with established guidelines
Interview candidates for position
Follow up on information provided on job applications
Recommend or select applicants for employment
Orient new employees
Maintain personnel records
Comply with labor contracts
Comply with Workers' Compensation guidelines

Provide for unconventional work schedules (e.g., flextime, shared positions)
Identify additional or alternative employee benefits that the company might consider furnishing to employees

BIL: Recommended
AC:

EDU:	12	AD
	I	**PR**

Competency 4.4: Manage employee performance

Competency Builders:
Apply management/leadership style appropriate for situation
Clarify roles and relationships using organizational charts
Communicate performance expectations
Clarify company policies and procedures
Create/maintain an environment supportive of productivity
Establish office procedures
Maintain office procedure manual(s)
Monitor employee performance
Maintain performance records
Document personnel issues
Evaluate employee performance
Provide employees with constructive criticism and feedback
Counsel employees
Discipline employees
Make recommendations based on employee performance (e.g., transfer, promotion, or dismissal)
Manage the change process (e.g., for right-sizing, technological updating, globalization, retraining)
Adhere to company policies and federal laws governing discrimination and harassment
Demonstrate sensitivity to diversity, including differences in gender, culture, race, language, physical and mental challenges, and family structures
Apply knowledge of motivational theory in selecting management techniques

BIL: Recommended
AC:

EDU:	12	AD
	I	**IR**

Competency 4.5: Perform strategic planning functions

Competency Builders:
Guide the planning process using problem-solving, decision-making, and critical thinking strategies
Analyze needs
Secure needed information through research
Develop goals and objectives
Prioritize goals and objectives
Develop action plan for achieving objectives
Project trends and outcomes using forecasting techniques
Prepare budgets
Analyze budgets
Develop strategic plan

BIL: Recommended
AC:

EDU:	12	AD
	I	**R**

Competency 4.6: Perform routine management functions

Competency Builders:
Guide the management process using problem-solving, decision-making, and critical thinking strategies
Develop management objectives
Conduct task analyses
Create/maintain organizational and/or departmental charts
Maintain procedure manuals

Solve space utilization problems using math and problem-solving skills
Follow the chain of command
Maintain confidentiality
Clarify company policies and procedures
Communicate cost-containment factors
Monitor budget activity
Prepare managerial reports
Analyze daily production reports
Represent the organization to the public

BIL: Recommended
AC:

EDU:	12	AD
	1	**R**

Competency 4.7: **Manage work flow and operations**

Competency Builders:
Plan physical layout and work flow
Illustrate business or job procedures/operations using flowcharts
Prioritize work
Establish/maintain operating policies and procedures
Establish/maintain production standards
Establish/maintain linkages with other departments
Systematize work
Delegate work
Communicate operating policies and procedures, priorities, linkages, and standards to others
Provide work assignments and instructions
Monitor progress
Solve work flow/operations problems using problem-solving, decision-making, and critical thinking strategies
Prepare productivity reports
Communicate contents of productivity reports to others in accordance with company procedures

BIL: Essential
AC:

EDU:	12	AD
	I	**P**

Competency 4.8: **Maintain company security**

Competency Builders:
Access needed information using company references
Plan security procedures in accordance with business ethics
Communicate security procedures internally
Ensure compliance with security procedures
Document security procedures
Perform security checks
Correct security problems

BIL: Essential
AC:

EDU:	12	AD
	I	**P**

Competency 4.9: **Support the company's social and community involvement**

Competency Builders:
Propose environmental, educational, and community needs and social issues on which to focus company support
Select issues on which to focus company support
Participate in social and/or community activities
Encourage staff involvement
Recognize the importance of the company's social and community relationships and their effects on the company

Unit 5: Customer Relations

BIL: Essential
AC:

EDU:	12	AD
	P	**PR**

Competency 5.1: **Demonstrate positive relations with customers**

Competency Builders:
Identify importance of customers to business
Differentiate between customer needs and wants
Comply with dispatch orders
Calculate job cost estimate
Provide prompt and courteous service
Resolve customer inquires and complaints and/or refer customer to appropriate person
Identify methods of addressing dissatisfied customers
Make thoughtful commitments
Demonstrate proper phone etiquette
Write service report

BIL: Recommended
AC:

EDU:	12	AD
	IR	**PR**

Competency 5.2: **Perform scheduling functions to meet customer's needs**

Competency Builders:
Create calendar/schedule
Maintain appointment calendars
Process requests for appointments
Verify appointments

Notify customer of changes in schedule
Manage scheduling conflicts

Unit 6: Troubleshooting and Repair

BIL: Essential
AC:

EDU:	12	AD
	P	**R**

Competency 6.1: **Demonstrate troubleshooting skills**

Competency Builders:
Explain role of preventive maintenance
Differentiate normal and abnormal operations
Explain troubleshooting procedures
Explain logical actions taken to troubleshoot
Use proper troubleshooting aids
Demonstrate knowledge of safety rule for troubleshooting and repair procedures
Maintain troubleshooting and repair records
Use manufacturer's manuals, schematics, and troubleshooting charts
Isolate faults, shorts, and open circuits

BIL: Essential
AC:

EDU:	12	AD
	P	**R**

Competency 6.2: **Apply troubleshooting techniques to DC circuits**

Competency Builders:
Identify noise problems
Isolate faults in series, parallel and series parallel
Isolate faults in bridge circuits
Isolate faults in DC power supplies
Perform polarity check
Isolate faults to DC drive system

Isolate faults in voltage divider circuits
Repair faults

BIL: Essential
AC:

EDU:	12	AD
	I	**P**

Competency 6.3: **Apply troubleshooting techniques in discrete solid-state devices**

Competency Builders:
Isolate faults in diode circuits
Isolate faults in thyristor circuitry (e.g., SCR, TRIAC, DIAC)
Isolate faults in transistor circuits
Isolate faults in operational amplifier circuits
Isolate faults in single-stage amplifiers
Repair faults

BIL: Recommended
AC:

EDU:	12	AD
		I

Competency 6.4: **Apply troubleshooting techniques to analog circuits**

Competency Builders:
Isolate faults in single and multistage amplifiers
Isolate faults in audio power amplifiers
Isolate faults in regulated and switching power supply circuits
Isolate faults in active filter circuits
Isolate faults in oscillator circuits
Isolate faults in operational amplifier circuits

Isolate faults in power supplies (loaded and unloaded) and filters
Repair faults

BIL: Recommended
AC:

EDU:	12	AD
		I

Competency 6.5: **Apply troubleshooting techniques to digital circuits**

Competency Builders:
Identify noise problems
Isolate faults in multiplexer and demultiplexer circuits
Isolate faults in logic gates
Isolate faults in arithmetic-log circuits
Isolate faults in encoders and decoders
Isolate faults in digital-display devices
Repair faults

BIL: Essential
AC:

EDU:	12	AD
	I	**P**

Competency 6.6: **Apply troubleshooting techniques to a microcomputer system**

Competency Builders:
Isolate faults to systems boards
Isolate faults to memory circuits
Isolate faults to data storage devices
Isolate faults in power supplies
Troubleshoot I/O ports
Isolate faults in I/O interface circuitry
Use diagnostic software

Repair faults

Unit 7: Electrical Theory

BIL: Essential
AC:

EDU:	12	AD
	P	**R**

Competency 7.1: Explain basic electrical theory

Competency Builders:
Describe atomic structure and its relationship to electricity
Describe the relationship between electrical and magnetic properties
Describe the electrical and magnetic properties of a magnet
Describe the photoelectric effect
Describe the thermocouple effect
Describe the electrical effect of friction
Identify sources of electricity
Identify potential sources of electricity
Describe differences between AC/DC
Describe effects varying degrees of electricity have on the human body

BIL: Essential
AC:

EDU:	12	AD
	P	**R**

Competency 7.2: Explain operation of electrical distribution systems

Competency Builders:
Explain generation of electricity
Explain transmission of electricity

BIL: Essential
AC:

EDU:	12	AD
	P	**R**

Competency 7.3: Demonstrate proficiency in direct current (DC) circuits

Competency Builders:

Describe voltage, current, resistance, power, and energy
Solve algebraic problems to include exponential (prerequisite to DC)
Measure properties of a circuit using volt-ohm meter (VOM) and digital volt-ohm meter (DVM) meters and oscilloscopes
Apply Ohm's Law
Construct parallel circuits
Construct series circuits
Construct series parallel and bridge circuits
Define voltage divider circuits (loaded and unloaded)
Construct DC circuits that demonstrate the maximum power transfer theory
Solve problems in electrical units utilizing metric units
Describe the principles and operation of electrochemical supplies
Apply Kirchoff's law
Interpret color codes and symbols to identify electrical components and values
Measure properties of a circuit using analog and digital meters and oscilloscopes
Measure conductance and resistance of conductors and insulators
Describe magnetic properties of circuits and devices
Describe the physical and electrical characteristics of capacitors and inductors
Describe RC and RL time constants
Set up power supplies for DC circuits
Operate power supplies for DC circuits
Analyze frequency spectrums
Apply Thevenin's and Norton's theorems

BIL: Essential
AC:

EDU:	12	AD
	IR	**P**

Competency 7.4: **Demonstrate proficiency in alternating current (AC) circuits**

Competency Builders:

Analyze AC signals utilizing VOM, DVM, oscilloscope, frequency counter, and function generator
Measure power in AC circuits
Analyze properties of an AC signal
Identify AC sources
Describe the principles and operation of the characteristics of capacitive circuits
Describe the principles and operation of the characteristics of inductive circuits
Demonstrate the operation of inductive circuits
Describe the principles and operation of the principles of transformers
Demonstrate the operation of AC circuits utilizing transformers
Describe basic motor theory and operation
Describe basic generator theory and operation
Operate power supplies for AC circuits
Describe the principles and operation of various power conditioning (e.g., isolation transformers, surge suppressors, uninterruptable power systems)
Describe the principles and operation of various safety grounding systems (e.g., lightning arresters, ground fault interrupters, etc.)

BIL: Essential
AC:

EDU:	12	AD
	IR	**P**

Competency 7.5: **Demonstrate proficient use of electrical measurement equipment**

Competency Builders:
Describe function and operation of analog volt-ohm-meter (AVM)
Describe function and operation of digital volt-ohm-meter (DVM)
Describe function and operation of amp probe
Describe function and operation of oscilloscopes
Describe function and operation of operation of infrared heat sensor
Apply measurement equipment to DC circuits
Apply measurement equipment to AC circuits
Apply measurement equipment to solid-state devices
Apply measurement equipment to digital circuits
Apply measurement equipment to analog circuits
Apply measurement equipment to microprocessors

Unit 8: Equipment Maintenance

BIL: Essential
AC:

EDU:	12	AD
	P	**PR**

Competency 8.1: **Perform housekeeping**

Competency Builders:
Dispose of scrap metal chips, shavings, trash and waste
Clean work area
Store hand tools, cutters, fixtures, jigs, and attachments
Store grinding wheels
Follow tool crib procedures
Inspect machine guards
Replace or adjust machine guards
Report problems to supervisor

BIL: Essential
AC:

EDU:	12	AD
	I	**PR**

Competency 8.2: **Perform recordkeeping**

Competency Builders:
Explain reasons for keeping maintenance records
Explain reasons for keeping cost records
Complete work order
Complete internal requisition
Complete external requisition
Complete time cards
Complete job status reports
Complete equipment failure reports

Record preventive maintenance activities
Record repair activities
Read job orders and process sheets
Locate tooling and set up information
File reports
Prepare new/replacement equipment recommendations

BIL: Essential
AC:

EDU:	12	AD
	1	**PR**

Competency 8.3: **Inspect machine systems**

Competency Builders:
Explain planned maintenance
Explain preventive maintenance measures (e.g., lubrication)
Log machine histories
Explain machine system(s) calibration
Inspect linkages and lever mechanisms
Inspect drive couplings
Inspect clutches
Inspect roller ball bearings
Inspect safety systems
Analyze system failure
Make minor adjustments/repairs
Coordinate maintenance services

BIL: Recommended
AC:

EDU:	12	AD
	I	**I**

Competency 8.4: **Perform machine maintenance**

Competency Builders:
Use operator's and manufacturer's manuals
Operate individual machines
Diagnose malfunctions
Apply lockout/tagout procedure
Disassemble defective section
Clean equipment
Lubricate equipment
Check equipment for wear and alignment
Repair or replace defective parts
Test machine for performance
Make minor adjustments to equipment
Prepare planned maintenance schedules
Explain breakdown maintenance

BIL: Essential
AC:

EDU:	12	AD
	P	**R**

Competency 8.5: **Operate hand tools**

Competency Builders:
Demonstrate use and care of measuring devices (e.g., rules, tapes, calipers, micrometers, multimeter, thermometer, and coordinate measuring system)

Demonstrate use and care of common hand tools

Demonstrate proper metal working bench skills (including use of vices, hacksaws, files, tapes, dies, and reamers)

Demonstrate use and care of pipe clearing equipment

BIL: Essential
AC:

EDU:	12	AD
	P	**R**

Competency 8.6: **Operate portable power tools**

Competency Builders:
Demonstrate use and care of light-duty and heavy-duty drills
Demonstrate use and care of electric hammers
Demonstrate use and care of pneumatic drills and hammers
Demonstrate use and care of power screwdrivers and impact wrenches
Demonstrate use and care of belt, pad, and disc sanders
Demonstrate use and care of grinders
Demonstrate use and care of lifts

BIL: Essential
AC:

EDU:	12	AD
	P	**R**

Competency 8.7: **Operate stationary equipment**

Competency Builders:
Demonstrate use and care of mechanical presses
Demonstrate use and care of hydraulic presses
Demonstrate use and care of drill presses
Demonstrate use and care of bench grinders
Demonstrate use and care of power saws (e.g., hack, cut-off, chop, band, jig, and table)

Unit 9: Mechanical Power Distribution

BIL: Essential
AC:

EDU:	12	AD
	IR	**PR**

Competency 9.1: **Demonstrate knowledge of basic mechanics**

Competency Builders:
Explain working forces of torque, tension, and compression
Explain the laws of motion
Explain how to calculate work in several ways
Explain the function of simple machines including levers, inclined plane, wedge wheel and axle, pulley and screw, gears
Explain the types of power and the method of producing power
Explain the laws of friction
Explain mechanical efficiency
Apply basic knowledge of physics
Calculate speed changes

BIL: Essential
AC:

EDU:	12	AD
	I	**P**

Competency 9.2: **Describe mechanical power distribution systems**

Competency Builders:
Describe the principles and operation of compound and reverted gear trains
Describe the principles and operation of internal and planetary gear trains
Describe the principles and operation of helical and bevel gear trains
Describe the principles and operation of rack and pinion, worm and wheel, and block and screw mechanisms

Describe the principles and operation of counter rotating mechanisms and differentials
Describe the principles and operation of spring mechanisms, pulley blocks, and differentials
Describe the principles and operation of chain, belt and disc drives and universal joints
Describe the principles and operation of clutch and coupling mechanisms
Describe the principles and operation of braking mechanisms
Describe the necessity for proper alignment and fit of mechanical devices
Describe the necessity for proper balance of system components
Describe proper component matching (e.g., sheave sets, gear sets)

BIL: Essential
AC:

EDU:	12	AD
	P	**PR**

Competency 9.3: Use bearings

Competency Builders:
Define bearing
Define bearing theory
Define bearing purpose
Identify types of bearings and their applications
Identify installation method
Install bearings
Maintain bearings (e.g., lubrication)
Remove bearings
Identify bearing failure modes

BIL: Essential
AC:

EDU:	12	AD
	P	PR

Competency 9.4: **Use seals**

Competency Builders:
Define seal
Define seal theory
Define seal purpose
Identify types of seals and their applications
Identify installation method
Install seals
Maintain seals
Remove seals
Identify failure modes

BIL: Essential
AC:

EDU:	12	AD
	IR	**PR**

Competency 9.5: **Use gears**

Competency Builders:
Define gears
Define gear theory
Define gear purpose
Explain impact of electronic systems on gears
Identify types of gears, their materials, and their applications
Identify installation method
Install gears
Maintain gears (e.g., lubrication)

Remove gears
Identify failure modes

BIL: Essential
AC:

EDU:	12	AD
	P	**PR**

Competency 9.6: **Use belts and pulleys**

Competency Builders:
Define belts and pulleys
Define belt and pulley theory
Define belt and pulley purpose
Explain impact of electronic systems on belts and pulleys
Identify types of belts and pulleys and their applications
Identify installation method
Install belts and pulleys
Maintain belts and pulleys
Remove belts and pulleys
Identify failure modes

BIL: Essential
AC:

EDU:	12	AD
	P	**PR**

Competency 9.7: **Use sprockets and chains**

Competency Builders:
Define sprockets and chains
Define sprocket and chain theory
Define sprocket and chain purpose
Explain impact of electronic systems on sprockets and chains

Identify types of sprockets and chains and their applications
Identify installation method
Install sprockets and chains
Maintain sprockets and chains
Remove sprockets and chains
Identify failure modes

BIL: Essential
AC:

EDU:	12	AD
	IR	**PR**

Competency 9.8: **Use cams and levers**

Competency Builders:
Define cams and levers
Define cam and lever theory
Define cam and lever purpose
Explain impact of electronic systems on cams and levers
Identify types of cams and levers and their applications
Identify installation method
Install cams and levers
Maintain cams and levers
Remove cams and levers
Identify failure modes

BIL: Essential
AC:

EDU:	12	AD
	IR	**PR**

Competency 9.9: **Use clutches and brakes**

Competency Builders:
Define clutches and brakes
Define clutch and brake theory
Define clutch and brake purpose
Explain impact of electronic systems on clutches and brakes
Identify types of clutches and brakes and their applications
Identify installation
Install clutches and brakes
Maintain clutches and brakes
Remove clutches and brakes
Identify failure modes

BIL: Essential
AC:

EDU:	12	AD
	I	**P**

Competency 9.10: **Install drive components**

Competency Builders:
Identify types of couplings and their applications
Define drive component theory
Install solid coupling
Install jaw coupling
Install molded rubber coupling
Install chain type coupling
Align bearings, bushing, and cams
Install belts and adjust tensions

Explain the purposes and advantages of a chain drive system in relation to a belt drive system
Explain the function of speed reducers
Explain the function of gears and variable speed reducers
Install shafts
Align shafts
Mount drive sprockets and chains
Mount gears on open gear drives
Align gears on open gear drives
Install a mechanical clutch system
Install adjustable speed drives
Troubleshoot adjustable speed drives
Explain the operation of fluid couplings/torque converters
Install torque converters
Perform preventive maintenance on drive components
Inspect completed work
Describe types of fit and tolerances
Explain importance of balance
Explain impact of electrical systems on drive components

BIL: Essential
AC:

EDU:	12	AD
	IR	**PR**

Competency 9.11: Demonstrate knowledge of levers, linkages, and mechanisms

Competency Builders:
Describe class one, two, three, and compound levers
Describe the principles and operation of rocker arm and bell crank linkages and combined mechanisms
Describe the principles and operation of drag link and intermediate mechanisms
Describe the principles and operation of cam mechanisms
Describe the principles and operation of pivoted follower mechanisms
Describe the principles and operation of toggle, quick return, and ratchet mechanisms
Explain impact of electronic systems on mechanisms, linkages, and levers

BIL: Essential
AC:

EDU:	12	AD
	IR	**PR**

Competency 9.12: **Apply knowledge of lubricants**

Competency Builders:

Explain the function of lubricants
Explain lubricant and friction theory
Explain purpose of lubricants
Explain the properties of oil lubricants and factors determining the selection of lubricants
Identify types and functions of lubricant additives
Describe types of circulating oils and their purposes
Describe lubricating systems, including the charts and methods used
Demonstrate proper grease application
Demonstrate proper grease application
Demonstrate proper lubricant storage and handling
Lubricate a piece of industrial equipment
Identify specified lubricant or equivalent
Identify specified lubricant or equivalent
Explain lubricant recovery and disposal
Explain use of oil analysis reports

Unit 10: Hydraulics and Pneumatics

BIL: Essential
AC:

EDU:	12	AD
	I	**P**

Competency 10.1: Describe fluid concepts

Competency Builders:
Explain Pascal's Law
Explain Boyle's Law
Explain Bernoulli's Law
Describe flow velocity
Explain how heat and pressure relate to power and transmission
Describe physical properties of a fluid
Describe fluids in motion in closed conductors
Describe continuity of mass flow
Identify types of fluids
Identify properties of fluids
Identify English and metric units of measurement for pressure, density, and viscosity
Explain impact of electronic systems on pneumatic systems

BIL: Essential
AC:

EDU:	12	AD
	I	**P**

Competency 10.2: Describe energy conservation

Competency Builders:
Differentiate work and power
Differentiate potential and kinetic energy
Explain energy conservation concept

Explain hydraulic horsepower
Explain work of compression in compressible fluids

BIL: Essential
AC:

EDU:	12	AD
	I	**P**

Competency 10.3: Describe system losses

Competency Builders:
Differentiate turbulent and laminar flow
Explain friction factor
Explain pressure losses
Identify potential system losses (e.g., leaks, wear, component sizing, heat, dirt)

BIL: Essential
AC:

EDU:	12	AD
	I	**P**

Competency 10.4: Describe hydrostatics

Competency Builders:
Explain pressure, density, and viscosity
Explain buoyancy
Explain equilibrium

BIL: Essential
AC:

EDU:	12	AD
	I	**P**

Competency 10.5: Calculate energy

Competency Builders:
Apply Pascal's Law
Apply Bernoulli's Principle
Apply Boyle's Law
Calculate work and power
Calculate potential and kinetic energy
Calculate hydraulic horsepower
Calculate flow velocity and pressure
Calculate pressure losses
Calculate laminar flow
Calculate pump capacity
Calculate systems requirements

BIL: Essential
AC:

EDU:	12	AD
	IR	**PR**

Competency 10.6: Describe component system

Competency Builders:
Use common symbols
Create circuit diagrams (i.e., schematics)
Diagram closed-loop hydraulic system
Diagram an air supply system

BIL: Essential
AC:

EDU:	12	AD
	IR	**PR**

Competency 10.7: Describe component operation

Competency Builders:
Identify functions and operation of hydraulic components
Identify functions and operation of phenmatic components
Explain application(s) of different materials

BIL: Essential
AC:

EDU:	12	AD
	IR	**PR**

Competency 10.8: Interpret hydraulic and pneumatic schematics

Competency Builders:
Identify common symbols
Sketch circuit diagrams (i.e., schematics)
Interpret circuit analysis
Sketch circuit analysis
Diagram an air supply system

BIL: Essential
AC:

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	IR	**PR**

Competency 10.9: Troubleshoot hydraulic and pneumatic circuits

Competency Builders:
Analyze hydraulic circuits
Troubleshoot hydraulic circuits
Analyze pneumatic circuits
Troubleshoot pneumatic circuits

BIL: Essential
AC:

EDU:	12	AD
	IR	**PR**

Competency 10.10: Perform pump maintenance and repair

Competency Builders:
Identify types and operating features of pumps
Identify pump capacity and system requirements
Explain packing and seal requirements
Explain operating principles of pumps (e.g., centrifugal, propeller and turbine rotary, metering)
Perform pump maintenance
Disassemble a pump
Reassemble a pump

BIL: Essential
AC:

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Competency 10.11: Maintain piping and accessories for high and low pressure fluid power systems

Competency Builders:

Identify components of a piping system
Explain maintenance features of both metallic and non-metallic piping systems
Explain types of valves and their operation and maintenance
Explain use of maintenance of strainers, filters, and traps in piping systems
Join common fittings
Join metallic pipe

BIL: Essential
AC:

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Competency 10.12: Troubleshoot hydraulic systems

Competency Builders:

Interpret hydraulic schematic
Identify causes of failure modes
Connect electrically controlled valves
Explain hydraulic system troubleshooting techniques
Repair or replace hydraulic valves
Repair or replace hydraulic cylinders
Repair or replace hydraulic pumps and motors
Install hydraulic components

BIL: Essential
AC:

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	IR	**PR**

Competency 10.13: Maintain vacuum systems

Competency Builders:

Describe characteristics associated with vacuum systems and sub-atmospheric pressure
Describe the principles and operation of vacuum gauges
Demonstrate use of vacuum gauges
Repair or replace vacuum gauges
Describe the principles and operation of vacuum pumps
Demonstrate use of vacuum pumps
Repair or replace vacuum pumps
Describe the principles and operation of vacuum controls
Demonstrate use of vacuum controls
Repair or replace vacuum controls
Describe effect of electronic system on vacuum system
Explain impact of electronic systems on vacuum systems

Unit 11: Basic Materials Science

BIL: Recommended
AC:

EDU:	12	AD
	I	**R**

Competency 11.1: **Demonstrate basic knowledge of metallurgy**

Competency Builders:
Define metallurgy
Define metal forming (e.g., general process)
Identify forming industries (e.g., stamping, forging, fabricating)
Describe metal forming principles
Describe the metal forming process
Identify frequently used metals
List physical properties of common metals
Describe measures of metal strength
Identify examples of raw materials processed by hot rolling, cold rolling, forging, drawing, extrusion, spinning and powered metallurgy
Explain secondary finishing operations (e.g., paint, anodizing)

BIL: Recommended
AC:

EDU:	12	AD
	I	**R**

Competency 11.2: **Demonstrate basic knowledge of metal characteristics and formability**

Competency Builders:
Explain metal grades and coatings
Explain tensile test
Explain surface test
Describe process of heat treating

Define types of heat treating (e.g., case hardening, annealing, drawing, stress relieving, tempering, quenching, critical temperature)

BIL: Recommended
AC:

EDU:	12	AD
	I	**R**

Competency 11.3: **Demonstrate basic knowledge of casting**

Competency Builders:
Identify frequently used metals
List physical properties of common metals
Define permanent mold casting
Define shell mold casting
Define sand casting and pattern making
Define die casting
Identify basic casting materials
Identify advantages/disadvantages of casting processes

BIL: Recommended
AC:

EDU:	12	AD
	I	**R**

Competency 11.4: **Demonstrate knowledge of corrosion and protection**

Competency Builders:
Identify causes of corrosion
Identify types of corrosion
List solutions to minimize problems
Identify corrosion testing

BIL: Recommended
AC:

EDU:	12	AD
	I	**R**

Competency 11.5: **Demonstrate basic knowledge of rubber manufacturing**

Competency Builders:

Compare properties of natural rubber with those of synthetic rubber
Explain vulcanization, mastication, and cure systems
Explain how synthetic rubber is manufactured (e.g., neoprene, butyl, styrene-butadiene)

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